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[ILLUSTRATED]

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Torpedoes for Defence and Attack.

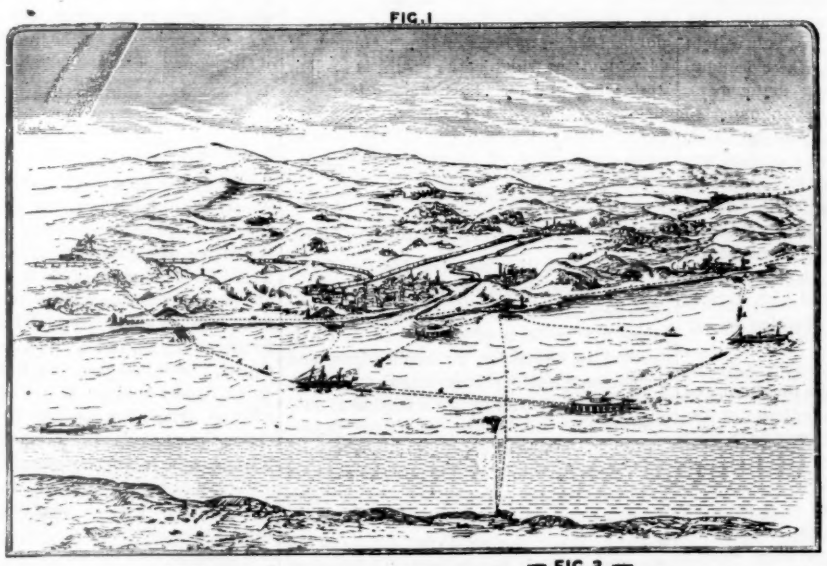
The activity displayed by the various governments of the world in torpedo warfare declares plainly that the importance of the torpedo as a weapon of offence and defence is now fully recognized.

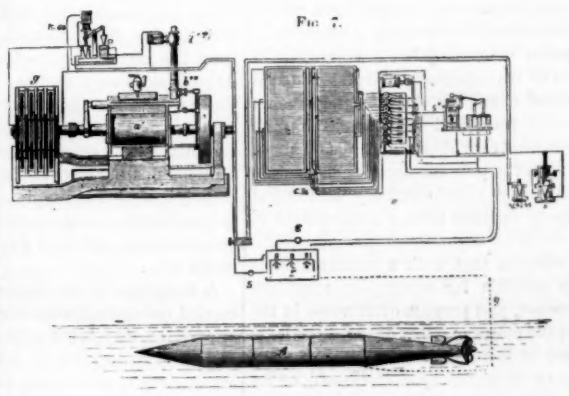
The amount of actual destruction effected by its use has not, however, since its introduction, been extensive, and therefore the present position which this weapon holds in the estimation of those who are competent to deal with it is an evidence both to its power of destruction, which induces great care in guarding against attacks, and to the moral effect produced by its employment in preventing operations of attack being undertaken where the presence of torpedoes is expected. It is obvious that as the efficiency, speed, and range of the powers of the torpedo are increased, the advantages arising from its employment will accrue in greater measure to those powers which are fully equipped with such an arm.

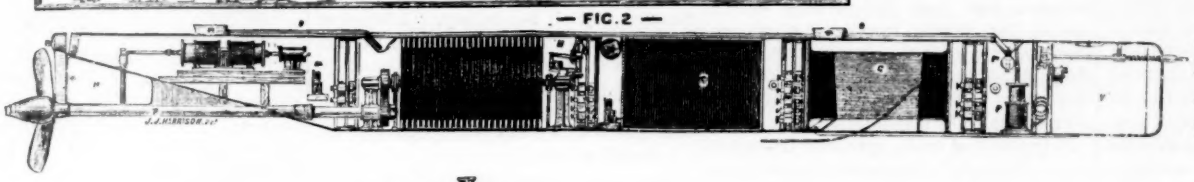
We illustrate on this page some improvements in torpedoes and the methods of using them, which are an advance in the direction which it seems to us that improvement is sure to take. These improvements are in connection with the class of torpedoes known as "movable" or "locomotive" torpedoes, which are distinct from the fixed submarine or submerged mines, formerly the only known form of marine torpedoes. But the improved torpedo is also distinct from the "Whitehead" and "Fish" torpedoes (these being prominent examples of the movable or locomotive class), because it has the added feature expressed by the term "controllable." That is to say, the torpedo is not only propelled through the water without being accompanied by a single man, but it is also controlled in all its movements during its entire course, which may extend to a distance of two miles. The importance of this feature in such appliances has been recognized by experts for a number of years. The first to propose a crude method of carrying out the idea was, we believe, Captain Ballard, an English officer stationed in India, who suggested a method of working the rudder electrically through an electrical cable connected with the shore, about the year 1869. In the experiments made with his plan only an ordinary ship's launch was used, as the experiments took place before the introduction of even the modern torpedo launch, and although at that time no means were known by which a torpedo could be made to run under water, yet it was recognized that the full value of the system of controlling marine projectiles of the torpedo class could only be realized when such a torpedo was invented.

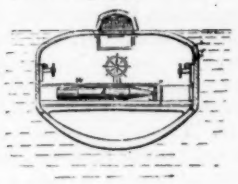
A considerable step towards the realization of these conditions was made by Colonel Lay, an American pioneer in the introduction and use of torpedoes in naval warfare, who invented and introduced the submerged torpedo which bears his name, with electrical appliances for controlling the rudder and the other mechanism of the projectile through an electrical cable, the motive power being an engine driven by compressed carbonic acid, the valves of which were also manipulated by electro-magnetic means. The use of such an agent for developing motive power necessarily restricted the use of this torpedo, and prevented its employment on a large scale in the equipment of men-of-war or at stations along any extent of coast, as it required special apparatus for manufacturing and compressing the carbonic acid, which could not conveniently be carried or worked on board ship or without considerable difficulty elsewhere. The weight of the engine on this plan was also equal per horse-power developed to that of steam engines, and this necessarily imposed a restriction upon the power, and therefore on the speed obtained in torpedoes of ordinary dimensions; and there were also difficulties to contend with, arising —as in the case also of torpedoes propelled by compressed air engines—from the cold produced by the expansion of the gas. Col Lay, however, demonstrated the absolute precision with which this class of torpedoes can be directed, in spite of adverse conditions sufficient to render uncontrolled torpedoes quite inoperative.

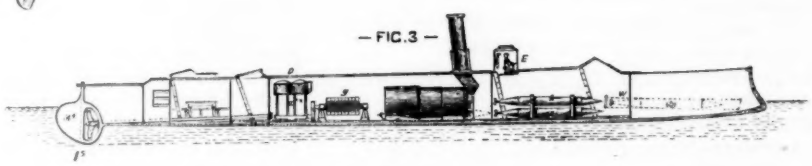
In the plans of Mr. J. S Williams, which we illustrate, electricity is employed both for the motive power and for all the appliances by which the various movements of the apparatus and of the torpedo itself are controlled.

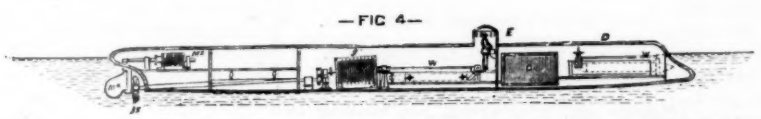


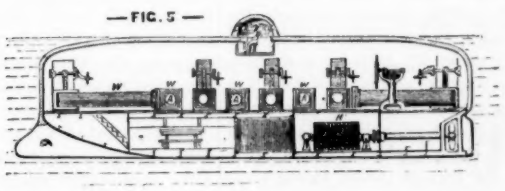












WILLIAMS' SYSTEM OF TORPEDO ATTACK AND DEFENCE.

The advantages arising from the employment of such an agent are numerous as regards the manipulation of the torpedo itself, and it is possible, as the plans indicate, to apply the system of working on an extended scale, so that the defence of harbors and coast lines can be carried out with great completeness and without involving large outlays of money.

In Fig 2 we illustrate a sectional elevation of the torpedo, which shows the magazine *V* in the bow of the vessel. Arrangements can be employed, as shown, for detaching it from the body of the torpedo on contact with the object attacked, allowing it to drop to a pre-determined distance under the ship, and for firing the charge electrically.

Immediately behind this is the electrical apparatus *P* for raising and lowering two r more sight rods, which carry hooded incandescent lamps (working either in the circuit of the accumulator on board or in that of the

cable) for indicating to the operator at the discharging station the direction of the torpedo's course, to enable him to steer it directly to the object attacked, in spite of the effects of adverse currents or of any change of position in the enemy's vessel.

Fixed sight rods may be used, or other means for indicating the position of the torpedo, as its speed is such that, even, although observed, it can scarcely be guarded against. The succeeding compartment contains the electrical cable *G* in a coil which allows the cable to pay out itself as the torpedo advances, and thus prevent any drag on the motion of that vessel.

The accumulator or secondary battery is placed next, and this appliance has been so much improved by Mr. Williams that on his plan it is possible to store in the small space at command an amount of energy representing the power necessary for a speed of twenty-five miles an hour, and with a very small dead weight.

Interposed between the accumulator and the motor, in the electrical circuit of the cable, are variable resistances and other governing devices, by which the current passing to the motor is regulated automatically in accordance with the speed of the motor or with the electric pressure in the circuit from the accumulator. These devices are connected by the cable with a variable resistance at the switchboard and are operated thereby, and thus the supply to the motor can be regulated, controlled, or stopped at the will of the manipulator at the switchboard placed at the point whence the torpedo is dispatched.

The motor which adjoins is composed of a number of disk-shaped armatures fastened on a central shaft, the field magnets being also of disk form and so arranged that the armatures revolve within a distance of about $\frac{1}{64}$ inch from the pole surfaces. This enables an exceedingly high efficiency and great power to be realized from a small weight of motor.

It is obvious that such a construction is specially suitable for equipping torpedoes and launches, and permits of increase in the power of the motor in either of two directions, *i. e.*, either by increasing the number of disks of a given diameter upon the shaft, or by increasing the diameter of the disks, both of these methods giving increased power in direct ratio to the increase of size.

The mechanism for controlling the rudder is also worked electrically, and the force is regulated by at least one variable resistance, worked automatically or by hand, interposed in the electrical circuit of the cable and the keyboard. Through the medium of a circuit reverser and variable resistance, the direction of the current through the cable is controlled in such a manner as to move the rudder either to port or starboard, and, if desired, maintain it at any angle by simply varying the force of the current passing through the cable. The rudder mechanism can be worked by the energy stored up in the accumulator on board the torpedo, and in such case it is included in a circuit from the accumulator upon which circuit a variable resistance and circuit-closer operate, these devices being worked by the current passed through the paying-out cable. The current is regulated by a pressure regulator, and controlled by a circuit-reverser and variable resistance upon the keyboard.

Means are also employed for indicating the position in which the rudder is placed at any moment, and such position will correspond to some defined resistance introduced at any given moment in the circuit. This mechanism for operating the rudder may consist of an arrangement of compound solenoids, the armatures of which are connected to a lever on the rudder head, or a small electro-motor can be employed for operating worm gearing on or combined with the rudder head, the rudder being brought back to the midship or normal position by springs or counter balance weights.

Such electrical appliances are also applicable in the equipment and working of torpedo launches, and we illustrate in Fig. 4 a launch so fitted, and carrying a number of torpedoes in compartments, from which they are discharged and subsequently propelled toward and directed with precision against the object of attack.

Where torpedoes are not equipped with an accumulator, the motor can be driven direct from a dynamo machine through the electrical cable, provided with pressure regulating appliances and a keyboard, or from accumulators carried on board a launch or man-of-war, or stationed at any number of fixed points along a shore, or on board of floating batteries. Fig. 7 shows diagrammatically a torpedo so propelled, and in Fig. 3 a steam torpedo launch is shown having both a dynamo machine and accumulators on board, as well as a number of torpedoes. Figs. 5 and 6 illustrate a floating fort or battery carrying a considerable number of torpedoes and electrical apparatus for developing electrical force, or for charging accumulators for working the torpedoes or propelling the battery itself when desired. Such forts can be anchored in suitable positions for the defence of harbors or coasts, or propelled from place to place to within torpedo range of a fleet which it is intended to attack, or to a suitable position for supplying torpedo launches or torpedoes with electric power or for supplying torpedoes. A general plan illustrating the application of these appliances to the defence of coasts and harbors is given in Fig. 1. Electricity of high force is developed at a convenient generating station shown at *a*, and can be distributed or transmitted with high force along the coast through a light cable *a* to various stations *B*, where accumulators are placed (for storing the energy), which, when fully charged, are disconnected from the circuit automatically or by hand. At such stations a number of electrical torpedoes are held in reserve for supplying launches or for being discharged therefrom, and directed as occasion requires. At *F* is shown a floating torpedo battery, and also a branch cable *bc* for supplying electric power to launches or vessels equipped with electric accumulators, and at *D F* is a floating battery under way.

A branch from the supply cable is shown carried out some distance from the shore, and buoyed so that the floating batteries or torpedo launches shown at *C D* may have their accumulators recharged without requiring the vessels to go into harbor.

Torpedoes are represented at *A* as being discharged from the shore stations, floating batteries, and from the torpedo launch against two hostile ironclads, which are shown approaching the coast or harbor, and the paying-out electrical cables by which the movements of the torpedoes are controlled, are represented by dotted lines *G*.

In presence of such a system of defence it would obviously be practically impossible for a hostile fleet to damage ports or harbors; or even to land troops upon a coast so protected, and the adoption of such a system by this country would increase the effective power of the navy by relieving, for naval purposes, the large number of ironclads employed at present for guarding ports and harbors at home and abroad. Into the economical aspect of this subject we do not here enter at length, but it is very clear that for a given sum, expended in appliances for defence and attack, a much more effective and rapid return can be obtained from such a system than where the money is spent for the building of either ironclads or fortifications.—*Engineering.*

Self-Induction in Alternate Current Machines.

The following are the conclusions at which M. E. Hospitalier arrives in an article on this subject, in *L'Electricien* of 1st inst.:

The coefficient of self-induction of the circuit, both external and internal, plays an important part in alternate-current machines; and all the efforts of constructors should be directed to reduce it as much as possible. This result would be attained, in the external circuit, by using straight wires and always bringing the conductor and the return wire as near together as possible. Twists and spirals should be carefully avoided, as they increase the coefficient of self-induction in the external circuit, and tend to weaken the current, while at the same time needlessly increasing the expense. In the internal circuit an endeavor should be be made to diminish the coefficient of self-induction by reducing to a minimum the length of wire necessary—that is to say, by employing intense, contracted, and high-velocity fields. From these different points of view, the Ferranti machine has made a distinct step in advance, and is beginning to find imitators. The iron cores, supposed to be necessary in certain machines, for concentrating the magnetic fields and increasing the electromotive force, should disappear, to give place to means which attain the same object, without introducing disturbances due to an increased self-induction and the creation of intense Foucalt currents. In some machines, such as that of Gramme, for instance, the soft-iron armature of the induced (*l'induit*) is necessary for protecting the external portion of the wire from the action of the field, and for destroying the electromotive force of contrary direction which may be there developed; but this is a difficulty which it will be possible to remedy by modifying the winding and construction of the machine. The suppression of soft-iron armatures is therefore an improvement which should be introduced into all alternate current or continuous-current machines, inasmuch as modifications in their magnetism always resolve themselves, in the long run, into a more or less considerable consumption of energy, and because an increase in the coefficient of self-induction, which is the result, is itself a fresh cause of loss. This is an established fact as regards alternate-current machines; and a future article will deal with it in connection with those of continuous current.

Electricity at Antwerp Exhibition, 1885.

The classification adopted for the forthcoming Antwerp Exhibition, the buildings of which are making rapid progress, comprises five sections, of which the fourth is devoted to electricity, its applications, and the necessary motors for driving the machines that generate current. This section is subdivided into six groups, and these groups again into nineteen classes, as given below. An English edition of the classification is published, but it requires revision, or those unacquainted with the French language might be at sea; for we do not generally use the term "pile" for battery, "bobbins of induction" for induction coils, nor "drums of resistance" for resistance coils.

GROUP X.—GENERAL MECHANISM.

Class 84—Boilers, steam engines, gas engines, hydraulic motors.

GROUP XI.—PRODUCTION OF ELECTRIC CURRENT.

Class 85—Hydro-electric, thermo-electric, and secondary batteries.
Class 86—Magneto-electric and dynamo-electric machines and induction coils.

GROUP XII.—ELECTRIC CONDUCTORS.

Class 87—Cables, wires, and accessories.
Class 88—Lightning conductors.

GROUP XIII.—THE STUDY AND TUITION OF ELECTRICAL SCIENCE, AND ITS SCIENTIFIC APPLICATION.

Class 89—Instruments used in experiments and demonstrations, *e. g*, electrical machines depending on friction or induction, condensers, electrophores, apparatus for electro-dynamic or electro-magnetic experiments, apparatus for the study of induced currents, etc.
Class 90—Measuring instruments: Mariners' compasses, rheometers, galvanometers, electro-dynamometers, standards of capacity and of resistance, resistance coils, rheostats, electrometers, etc.
Class 91—Electricity applied to astronomy, geodesy, and meteorology.
Class 92—Electricity applied to mechanics, Ballistics, physics, and chemistry.
Class 93—Electricity applied to the biological sciences; medical electricity.
Class 94—History and tuition of electrical science; books, drawings, and models; retrospective collections of apparatus.

GROUP XIV.—TRANSMISSION OF SIGNALS AND SPEECH BY ELECTRICITY.

Class 95—Telegraphs.
Class 96—Telephones, microphones, and photophones.
Class 97—Electricity applied to railways.
Class 98—Electrical signals for various purposes; indicators of levels, pressure, temperature, etc.; house telegraphs; electric clocks.

GROUP XV.—ELECTRIC CURRENT APPLIED TO INDUSTRY; VARIOUS APPLICATIONS.

Class 99—Electric lights; photometers.
Class 100.—Electric motors; transmission of power.
Class 101—Electrotyping.
Class 102—Miscellaneous applications.

The catalogue will be printed in both French and Flemish (which is almost the same as Dutch). Exhibitors have the right, for every group in which they are entered, to four lines of description free, and may pay for more space at a uniformly progressive rate, viz., 5f. (4s.) for the first extra line, 2f. for the second, and so on.

"The success of an exhibition depends in a great measure on the complete installation of the products at the time of its opening. Experience has proved that the delay which the installation has suffered on many occasions was principally due to the exhibitors, who either sent in tardily their demand for admission or neglected the timely forwarding of their products.

Conductors.

WRITTEN FOR POPULAR INFORMATION.

Called upon to write a popular article on the above subject, the writer was in a quandary how and what to write; as what to the electrician would be popular, to the layman would be incomprehensible from the number of strange terms and ideas suddenly thrust upon him. I could not well teach the electrician anything, but I have, in my duty as expert, found that there was a large field for an extremely popular, if the expression be allowed, article for the benefit of manufacturers, mechanics, engineers of mills, etc., who are now frequently brought face to face with that something and its appurtenances, about which we know so much, and yet so little, called electricity.

Although the researches of Andersohn, Edlund, Secchi, etc., seem to show us that electricity is a force, we will still think of it as a fluid, this being the former and for our purpose very convenient assumption, as we are not at present interested in the science of electricity, but in its manifestations as perceived by our senses. Considering electricity an immaterial fluid, without weight or volume, we can compare a dynamo (electric generator), and its circuit to a pump forcing water through a circuit of pipes, the pipes leading back to the pump, or to a gasometer with its pipes returning to it. We will find further on that in the matter of protection, electric circuits bear a close analogy to these systems. A gas or water circuit must be without breaks that no leakage may occur, and in order to increase the amount of gas or water flowing through a system we must enlarge the pipes and reduce the resistance in them (this is a very important point, and will undoubtedly be received as a startling, new, and original discovery by many of our Philadelphia officials), the amount of gas or water flowing through the circuit will change with the pressure developed by the gasometer or pump; applying these well-known principles to electricity we arrive at the fundamental principles in dynamic electricity. The amount of electricity flowing through a circuit will be inversely as the amount of resistance the circuit offers; that is, as in the case of gas and water, the more resistance in your circuit the smaller the amount you can draw from it at the end of the circuit. This resistance will depend on the length of the circuit and the size of the conductor—for the longer the gas, water, and electricity travels, the more resistance will it meet—and on the cross-section or size of the circuit for the smaller the conduit the more resistance there is. But there is a prin-

ciple, or rather difficulty, which we encounter in electricity which we have not in the case of gas and water; that is, we cannot make electricity flow inside of pipes, but it flows through solid material; its course is more like the flow of water through sand; and as water passes through certain materials more easily than through others, so electricity passes through some bodies more easily than others. Bodies have, according to their power of conducting electricity, been divided into conductors and non-conductors. Although these terms are only relative, for every body is a conductor, only that some are very good conductors and others conduct only with great difficulty, and are called insulators. There are also no perfect conductors, but every substance offers a certain amount of resistance to a current. The following classification of conductors, semi-conductors and non-conductors was compiled by Reiss :

CONDUCTORS :

Metals,	Rain Water,
Charcoal,	Snow,
Graphite,	Vegetables,
Acids,	Animals,
Saline Solutions,	Soluble Salts;
Sea Water,	Linen,
Spring Water,	Cotton.

SEMI-CONDUCTORS :

Alcohol,	Marble,
Ether,	Paper,
Flowers of Sulphur,	Straw,
Dry Wood,	Ice at 0° Cen.

NON-CONDUCTORS:

Dry Metallic Oxydes,	Dry Paper,
Oils,	Feathers,
Ashes,	Hair,
Ice at 25° Cen.,	Wool,
Phosphorus,	Dyed Silk,
Lime,	The Diamond,
Chalk,	Mica,
Rubber,	Glass,
Camphor,	Wax,
Essential Oils,	Sulphur,
Porcelain,	Resins,
Dried Vegetables,	Amber,
Leather,	Shellac.
Parchment,	

This table, which is arranged in the order of conductivity, illustrates how imperceptibly the divisions approach each other.

The following table is taken from the excellent little work on "Electric Lighting," by Prof. Henry Morton, Ph. D., and Mr. Wm. A. Anderson, which shows the relative conductivity of the better known metals; silver, the best conductor, being taken as the standard of comparison :

Pure silver	100 00
" copper (hard drawn)	96.00
" gold	74.00
" zinc (pressed)	29.00
" platinum (soft)	18.00
" iron "	16.8
" tin "	12.3
" lead "	8.3
" German silver (soft)	7.5
Mercury (commercial)	1.6

The foregoing shows that we also have a specific resistance in the case of electricity, which must be taken into account, which we have not in gas or water circuits.—*C. J. Hoxomer.*

The Future of Electricity and Gas.

Chambers' Journal, in an article upon this subject, says: "That the electric light has not proved a failure may be gleaned from a rough survey of what has been done during the past two years, in spite of unmerited depression and depreciation. In this country, permanent installations have been established at several theatres in London and the provinces; the Royal Courts of Justice, the Houses of Parliament, Buckingham Palace, Windsor Castle, the Bank of England, and other well known buildings, while numerous railway stations, hotels, clubs, factories, and private mansions throughout the country have also adopted the new light either entirely or in part. In addition to this, over forty steamships have been fitted with the electric light during the past year; and the Holborn Viaduct, with its shops and buildings, has been lighted without interruption for the past two years. On the continent, in addition to a large number of factories, private houses, and public buildings, numerous theatres at Paris, Munich, Stuttgart, Brunn, Vienna, Berlin, Prague, and Milan have been electrically lighted. In New York an installation of ten thousand lights has been successfully running for the last year or two. Any one wishing to see the electric light to advantage, and its suitability to interior decoration, should visit the Holborn restaurant. This building, with its finely decorated rooms, its architectural beauties, and ornamental designs in renaissance style, when viewed by the electric light, is without doubt one of the chief sights of London."

Scientific Societies.

The observing and thoughtful scientist views with anything but pleasure the rapid formation of associations for scientific study among our young men. He knows full well that they spring more from a desire to appear something they are not, than from necessity. The greatest gathering is generally at the birth of a society, and it is a rare thing to even have a second meeting as large as the first. Why is this? There is something wrong about it, and if we examine carefully we certainly shall be able to find the cause. It is a disease which might be compared to a fungus growth on the human intellect, and which is peculiarly American. The people of no other country are troubled with this disease. It is a premature, precocious desire for scientific greatness by young men who never would submit to excessive labor and self-denial, which real scientific research calls for. The scientific societies of the Old World, and the substantial ones in this, which have existed for generations, guard themselves as the citadels of old were guarded.

Let us see how we do these things in this country. One or two earnest workers, whose hearts are much larger in proportion than the brain, judging their fellowmen by themselves, and having a strong desire to do them good, decide to call a meeting of kindred spirits, which is no sooner thought of than done. The call is a glittering bait to young men, and quite a respectable number put in an appearance. The constitution and by-laws are adopted without argument as to their adaptability to the end sought. Why? Because no one but the compilers of the constitution and by-laws knows the first thing about them, and the whole matter is so hurried that each member is a stranger to all the rest. The members' names are enrolled, and it matters little what the conglomerate mass of humanity assembled may be, not a question is asked as to the merits or suitableness of a single member. The moral character or mental make-up is not for a moment taken into consideration. New members are elected in the same way, and are never put on probation for from one to six months, to give the old members a chance to determine whether they are proper associates or not. But the new members are proposed and elected in a few minutes' time, and are nearly always present, so that no modest man would object to any of them if he could offer opposition. It is well known that a true scientist, no matter what the field may be that he has chosen to work in, is a child of nature; science is truth to him, and he knows nothing else. He cannot associate with a man who possesses many of the vices, even if he has a desire to investigate, which is not often the case. To remain in the association, to a man of this kind, means trouble with the actions of his fellows—a kind of trouble that he always shuns. To avoid this, he quietly drops out of the association, and again investigates in solitude and alone, as before, and the society is weakened by the loss of one of its strongest, if not noisiest, members, and no one knows why. It is surprising how cheerfully a scientist gives of his hard-earned knowledge until he finds that it is going to a human sponge, which is publishing what it gets for a purely selfish purpose. Then, as with the society, sooner or later, our scientist again lapses into silence and solitude.

One of the greatest mistakes, for instance—and it is purely American—is to elect a lot of men to a microscopical society when not eight per cent. of the number either own or have ever used a microscope. It would certainly be as little as could be asked of a new applicant for membership that he should be the possessor of a microscope, and should have used it long enough to be able to pass an examination as to the name of each part of the instrument, and its use and possibilities, and give at least a synopsis of his microscopical career. Then he should be put on probation as to his moral and social fitness to be an associate member, and one black ball should count against him. If the president has reason to believe that the black ball was thrown in malice, he should have the power to demand an explanation in private, which, if not satisfactory to him, should be placed before the association for argument and vote without revealing the name of the person using the black ball, and this vote should be binding.

The writer has associated with scientists in every form for thirty years—as pigeon and poultry fanciers, botanists, and microscopists and all went to pieces for the same reason that the materials were too carelessly selected, and the association, as it were, not constructed with sufficient care. The greatest curse to association comes from selfish members. Some trade papers which lack home knowledge have some member of their staff join for just what they can get out of the association and no more; money is furnished to treat members, if necessary, and as scientists are not suspicious, this thing will continue for a time. Then, again, some members who are voted in without thinking prove like firebrands thrown into a tinder-box. There was one positive case where a person gained membership to a microscopical society for the sole purpose of annoying another member. This man was a queer compound of deception, treachery and untruthfulness, which was all indicated distinctly in his countenance, and yet he had no difficulty in securing membership. Is there any wonder that our scientific societies have a sickly birth, a miserable existence and almost an unnoticed death? But the true members live just the same as before—go on with their investigations as though societies were not brought into existence to die one after another, until finally, when gray hairs become plenty, one investigator, when asked to help form a new society, shakes his head and begins to talk about the last new "find" he had made, etc.

Is it not time to call a halt in our method of forming and managing scientific societies? It is time to stop "biting off more than we can chew." Scientific men certainly should learn wisdom from experience, if no others do. The Academy of Natural Science, at Philadelphia, was started by two members, quite young, and the first exhibition room for their specimens was in the basement of a dwelling. These two members knew each other. No dead wood there, no unprincipled interloper ever gained admittance as member. There was not the selfish trade paper to use their doings for a profit. The result is, the whole world looks on this institution with pride; and well it may, for its collection is unequaled, and its library is among the best in the world.

If solidity is sought in forming a scientific association, no matter what its object may be, let two to five members get together quietly, without any ostentatious call, and meet occasionally without an organization, and, if the plan works well and the enthusiasm holds out, then organize and guard well the association from the unworthy who seek to gain admission. Every original member has a right to say "yes" or "no" whether any new member shall be admitted or not, for every man has a right to choose those with whom he will associate. The old maxim is as true to-day as when it was first uttered, "Show me the company a man keeps, and I will tell you what kind of a man he is."—*Joseph M. Wade.*

—— The election of directors of the Edison Electric Light Company occurred last week, the combination ticket having been chosen without opposition. This ticket is as follows: E. D. Adams, J. H. Banker, C. H. Coster, Eugene Crowell, R. L. Cutting, Jr., Thomas A. Edison, W. L. Garrison, E. H. Johnson, F. R. Upton, J. Hood Wright, Erastus Wiman, Spencer Trask and Charles Batchelor. Mr. Eaton said that a report of the finances of the company had been prepared, and would be sent to the stockholders during the week. Speaking of his own retirement from official connection with the company, he said: "Mr. Edison has been for some past dissatisfied with the direction and executive management of the company. He wished to make use of money to push the enterprise, but some of the directors, including myself, were opposed to employing it upon the terms offered, deeming it unadvisable on account of the dullness in business everywhere. This was the occasion of his making an appeal to the stockholders for proxies. It is understood that active measures will now be taken to push the enterprise, and make some returns to the stockholders, no dividends having been paid since the company was formed.

—— A curious electric light accident is reported from Ithaca, N. Y. A housekeeper attempting to turn on the water at a sink rested her left hand against the metal of the sink, while with her right hand she turned the faucet. As she did so she was prostrated by a shock, which was at first supposed to be a stroke of paralysis. It was found, however, that she was uninjured, save that the thumb of her left hand was blistered, and a physician who was called in surmised that she had received an electric shock. A few few minutes afterwards another woman received a shock under similar circumstances, and attention was then directed to the sink. An electrician, instead of a doctor, was consulted, and he soon found the cause of the trouble. A "dead" private telegraph wire connected the house with a distant hotel. This dead wire had been crossed with an electric light conductor, and was also connected with the metallic roof of the house, and metallic connection was formed between the roof and the water pipes by means of the rain conductor.

—— Mr. A. A. Hayes, president of the Brush-Swan Electric Light Co., has submitted to the Commissioners of the District of Columbia an outline of his proposed underground system for lighting Pennsylvania Avenue with electricity. He said: "We propose using three cables of 'Callender Bitute,' packed in asphalt in a wooden box 8 inches by 6 inches. From our station in Second Street we will use a box of double size, carrying both positive and negative wires down alley to cross alley from B Street, down said alley to B Street, thence along B Street to pneumatic tube on North Capitol Street, and also along First Street to Pennsylvania Avenue; thence one box 8 by 6 inches is to run outside of curb line on north side of the avenue (the asphalt being removed and replaced by Belgian block), making such angles at crossings as you may direct, to Fifteenth Street northwest, and probably crossing there. Another box is to be laid across Pennsylvania Avenue to corner of Botanical Garden and First Street, thence under the brick sidewalk on south side of the avenue to Fifteenth Street. The work of taking up and relaying pavement of all kinds, and excavation, will be done by District workmen at the expense of the company." This proposition has to be approved.

—— Notice is given by the Lighthouse Board that on and after this date an electric light will be exhibited from the structure recently erected at Hell Gate, on Hallett's Point, Astoria, N. Y. This light is designed to illuminate the channel through Hell Gate, rather than as a beacon light. It will, however, unless accidentally extinguished, be visible on Long Island Sound, from a height of eighteen feet above the water, until cut out by Whitestone Point. Vessels approaching from the eastward, intending to go through Hell Gate, should note, after passing Whitestone Point, whether or not the light is visible.

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CONTENTS.

	PAGE
Torpedoes for Defence and Attack	1
Self-Induction in Alternate Current Machines	2
Electricity at Antwerp Exhibition	2
Conductors	2
The Future of Electricity and Gas	3
Scientific Societies	3
Editorials	4
The Electric Light in Buffalo	4
Editorial Notes from the Northwest	4
Standard Time	5
Telegraphers Mutual Benefit Association	5
Progress of Electrical Science	5
Telephonic News	6
Telephonic Synchronization	6
Old Cable Stories	6
The Association of Railway Telegraph Superintendents	7
Telegraphic	7
Glimpses of the International Electrical Exhibition	8
Electric Lighting at the International Health Exhibition in London	8
Electric Light News	9
New Electrical Patents	10

The members of the lighthouse board who witnessed the test of the electric light at Hallett's Point, Hell Gate, are enthusiastic over the success of the light. They say, however, that, in order to complete the illumination of Hell Gate so as to make it perfectly safe for navigation at night, it will be necessary to establish two more electric lights at adjacent points.

The electrical exhibition which is to be held in the Massachusetts Charitable Mechanics' Association building, gives every promise of being fully as interesting as the one recently held in Philadelphia. A great many novelties have been secured and nearly all the principal companies will be represented. One of the interesting exhibits will be the Bidwell electric railway. The car is propelled by electricity, and the same power also lights the incandescent lamp in the car and the arc lights along the railroad. The electric current is taken from a dynamo which can be run either by steam or water power, and conveyed to the tubes which carry the current along the railroad. A small wheel runs in the tubes and takes the current to the motor in the car.

The Electric Light in Buffalo.

By no means least among the electrical interests of this wide-awake and growing city is the electric light, which is seen everywhere upon the principal streets, both for street-lighting and for private use, in stores and other large buildings, and especially in the depots and freight houses, and yards of the various important railways having their termini here. It should be premised that there is but one electric light company here, and that it has, therefore, a monopoly of the business. It uses the Brush system exclusively, and now ten dynamos of about sixty lights capacity each. It has an exceedingly well-arranged station, each dynamo having a Westinghouse engine to furnish motive power, so that if one engine or machine breaks down there is a minimum of delay and interference with the proper burning of the lights. Before this company adopted the Westinghouse high-speed engine it had tried pretty much all the low-speed engines, with countershafting and belting, but it very sensibly came to the conclusion that that system could only result in waste of power and continual trouble, and it was through the teaching of a costly and wearisome experience that the present arrangement came to be determined upon.

So far the Westinghouse engines have given the most entire satisfaction, both as to quality of light produced and as to amount of steam used, although, in this latter respect, no very accurate data are at hand. As near as we can get it from the monthly consumption of coal, the lights cost, for fuel, five cents per light per night on the average. Under ordinary circumstances this would be considered cheap, but it is to be added that fuel does not cost the company over $1.90 per ton, delivered in the boiler-room. This fuel is soft-coal slack, and is burned in one of Murphy's patent smokeless furnaces, a contrivance of which we formed a decidedly favorable opinion. It burns the cheapest fuel, the feed is slow, regular, and automatic; perfect combustion is attained by the introduction of heated air, and that the furnace is "smokeless" is due to the fact—not that the smoke is consumed, but that no smoke is formed, for, as is well known, smoke is the result of imperfect combustion. Now, it seems to me, that with coal so cheap, five cents per night per light is high for fuel, especially with perfect combustion, and we should like very much to see figures of comparison with other places where a different make of engine is used.

Curiously enough, the company, which has in almost all respects shown great good judgment in the management of its affairs, was unwise enough to locate its central station on the west side of the town. Now, over three-fourths of its five hundred and odd lights are on the east side of the town, and all the growth that can reasonably be looked for, in lighting, is on that side also. Then, again, had the station been on the east side, a spur track could have been run into the boiler-room, and the thirty-cents carting, now paid on each ton of coal, reducing the cost of fuel to $1.60 per ton, might have been saved. But unfortunately people's foresight is never equal to their backsight, and through this mistake not only is the daily expense of running greatly increased, but the length of the circuits is far greater than they should be. This means much unnecessary copper wire, and copper wire means money.

Nevertheless, despite these mistakes, the company is doing well and making money; not such an immense amount of money, it is true, but enough to assure a dividend upon the capital, which represents not only the cost of the present plant, but of all the mistakes and experiments that led up to it. This, in view of the prevailing idea about arc lighting as a business, is a good and gratifying showing, and it may be added that the constant tendency to introduce new economies in operating is sure to put this company in first-rate shape.

The New England Telephone Company will complete its new central office at 50 Pearl street, Boston, early this month and with the latest style of Multiple Switch Board and other improved apparatus will no doubt give the Boston people in future a telephone service that they will be proud of.

Editorial Notes from the Northwest.

In a city which has had so rapid and wonderful a growth as Minneapolis, and whose most rapid and marked increase has been within the past five years—it has gained over one hundred and fifty per cent. in population in that time—it would be remarkable if electricity did not play an important part. In the East we are wedded to old ways, and when a new thing like electricity comes in, it has to crowd something else out of the way. But in this comparatively new city—there was not a single house here until years after the telegraph was introduced—it had a fair field in every direction except that of lighting, and it has been, if not from the city's childhood, certainly from its early boyhood, an important factor in its progress and development.

The telephone exchange here, which is the property of the Erie Telephone Company, is working admirably, and is giving excellent satisfaction. From my talk with various subscribers, I learn that the service here has been very greatly improved during the past few months, and that there was very great room for improvement. The service had run down, the instruments were not kept in proper adjustment or even clean, and there was continual cause of dissatisfaction and complaint. But all this has been changed, and the 963 subscribers to the Minneapolis exchange are, I have good reason to believe, as well served as they can ask. The rates charged are fair, but the demands upon the exchange are very great. Certainly, in this country, the public has not only learned to value, but to *use* the telephone, and use it they do on all possible occasions. In fact, in a great majority of cases here the subscriber gets altogether too much for his money—a difficulty which will not be remedied until the Buffalo system or its equivalent is introduced.

To show how true this is, let me cite the facts with regard to one of the subscribers here—a railroad company. I have forgotten which one it is, and it does not signify. There are a half dozen of them, and what is true of one is true of all On a certain day the said railroad office called *ninety* times. Out of these it got connections eighty-three times, the line wanted being busy seven times out of the ninety. On the other hand, it *was* called eighty-five times, and out of all these people that called only *five* got it, its line being found "busy" the other eighty times. Now it is clear that this railroad ought to have two instruments, one for outward and the other for inward business, and pay double price; but it will not do it, and is said to consider that it is doing a very handsome thing when it pays *seventy-two dollars a year* for this service. Under the Buffalo system it would pay for those ninety messages $3.90 per day, which, taking 300 days in the year for an inside figure, would mean $1,170 per annum. Moreover, if the ninety messages daily were necessary they would be worth the money, for a message that is not worth *four and one-third cents* to a railroad corporation is not worth sending at all; but the fact is that there would be very much fewer messages, because the use of the instrument would be limited to the company's needs, the strain upon the central office would be very much less, the operators could do their work very much more satisfactorily, and the service would be better in every way. It is certainly to be hoped that the Erie Company will have the courage to take hold of this matter at an early day, and—in these two cities of Minneapolis and St. Paul, at least—establish some sort of a pay-for-what-you-have system in place of the present inequitable and unjust arrangement, unjust at once to subscribers and to the company. The big users will "kick," of course, but they will not go out. Not they. They are just the men that can't afford to do without the service, and when they find that they have got to pay for it they will come to the front like little men and put up their money. I say I hope they will do it soon, because the sooner it is done the easier it will be to make the change. Reforming a system of telephone charges is a good deal like reforming a man given over to drink—the longer it is postponed the harder it is.

I find the exchange here installed in the City Hall. The wires come into the building in cables through a window, and are thence distributed to the switchboard, which is a Western electric multiple. It is working first rate, but when they set it up they made the mistake of putting its back to the light, so that it is not as easy for the girls to see their work as it might be. But, take it altogether, it is a good operating room, and the work goes on smoothly and quickly. There are ten or twelve trunk lines to St. Paul, and during the busy hours of the day there is a good deal of work done over them, something over a hundred messages a day each way, I believe. This does not seem much between two cities only ten miles apart, each of over 100,000 inhabitants; but the fact is that the feeling of rivalry between these two cities is so intense that it amounts to animosity, and no St. Paul man acknowledges the existence of Minneapolis if he can help it, and *vice versa*. Each considers itself an independent "metropolis," perfectly competent to stand alone and take care of itself, and if either does have to go outside of its own limits for anything, nothing short of actual starvation would induce it to go to its nearest neighbor. Minneapolis has no use for a man who is not of the opinion that St. Paul is rapidly sinking into insignificance, while St. Paul people make it tiresome for one who does not contend that the growth of Minneapolis is of the mushroom order, unstable, and destined to very early decay.

This Northwestern Division of the Erie Telegraph and Telephone Company has some twenty exchanges, as follows:

Albert Lea, Minn	42	subscribers.
Anoka, Minn	11	"
Bismarck, D. T	68	"
Brainard, Minn	33	"
Fargo, D. T	179	"
Faribault, Minn	56	"
Fergus Falls, Minn	38	"
Grand Forks, D. T	49	"
Huron, D. T	32	"
Mankato, Minn	88	"
Minneapolis, Minn	963	"
Northfield, Minn	35	"
Owatonna, Minn	35	"
Pierre, D. T	61	"
St. Paul, Minn	590	"
Sioux Falls, D. T	72	"
St. Cloud, Minn	29	"
Stillwater, Minn	96	"
Winona, Minn	74	"
Yankton, Minn	71	"

This is an aggregate of over 2600 subscribers, and there is a constant increase at all points. If the increase is not as rapid as had been hoped for, it is to be attributed to no fault of management, but to the one thing that is just now holding the whole Northwest in check, viz.: "No. 1 hard wheat, 50 cents a bushel." This means that the farmer cannot sell his crop, pay his debts, and get out whole. So he hangs on, hoping for better figures, and lives from hand to mouth on just as little as he can get along with, buys no luxuries of any sort or kind, and just as few of the necessities as possible. This, of course, means hard times for business men, and but little inclination to branch out into telephones or anything else. Let the farmer get back to 80 or 90 cents a bushel for his wheat and business would "hum" here, every one of the little exchanges above named would double and treble the number of their subscribers, and the telephone company would have another genuine "boom." That day is not far off, and when it comes things are going to be very festive in this town.

The electric light interests of pretty much of this city are in the hands of the Minnesota Brush Electric Light Company, which has the Brush franchise for the entire State. It

started in here two years ago with a very small plant, running by water power. It had a gas company to fight, a company that had a 50-year monopoly from the city of the right to run gas pipes through the streets, and thought it had also a monopoly of all lighting of every kind for all time to come. Hence it made very poor gas, and sold it at a high figure. It did its level best to keep the Brush Company from hanging its wires, and for a long time it succeeded, but after a time it had to give way, and, within sixty days from the time the first Brush light was started, it marked its gas down from $3.50 to $2.50 per thousand feet. Then the Brush Company put a very tall mast on Bridge Square, with eight four thousand candle lamps on it, and lighted up the surrounding streets for nothing. To let the people see the difference it had a way of turning the lights out every fifteen or twenty minutes, and then, after giving the natives a taste of darkness, turning them on again. This was more than they could stand, and so the city entered into a contract to pay for these lights, and pays the company well for it. It is a beautiful object to look at, but to my motion it is too high and does more illumination in the upper ether than the upper ether needs. It gives, nominally, thirty-two thousand candle power of light. Now I can't help thinking that if it were divided into sixteen lamps of a nominal two thousand candle power each, and these were placed along Hennepin and Nicollet avenues, and along the bridge, the *effective* light obtained would be very much greater. Besides this mast there are 8 or 10 city lamps on Washington avenue, and this is all the city lighting the company does. But it has quite a lot of private or commercial lights running, and the aggregate is about 225 in all.

During the past summer the company abandoned the use of water power as being unsatisfactory and unreliable, and has now what is destined to be one of the finest arc lighting stations in the country. It is near the river, so that the supply of water can never fail. It is within five hundred feet of a saw mill, with which a contract has been made to take all its sawdust for a term of years. This is brought over by means of an endless belt, running constantly, and costs nothing except the power required to run the belt. It is the only fuel used, and thousands of cords are stacked up in the yard outside against need in winter, when the mill does not run. The boilers are large tubulars, and there is always an abundance of steam. There are three Reynolds-Corliss engines, one of 275 horse-power, one of 225, and one of 175, an aggregate of 675 horse-power, enough for all the lights that the city is likely to need for a long time to come. The engines are handsome and well made, but I think it would have been wiser to have had them of the high-speed variety, more of them, and each one belted direct to one or, at most, two dynamos. But when people get fuel for nothing they can afford the loss which countershafting inevitably entails.

Besides its arc lights, the company has been doing considerable in the way of incandescent lighting, using the Brush-Swan lamps and storage batteries. The latter have not proved satisfactory. The plates disintegrate, "buckle-up," and go to pieces generally, and the batteries prove very troublesome after a very brief service. Like the school-girl, "when they are good, they are very good, but when they are bad they are horrid," and they are "horrid" the bulk of the time. This company has given the system a good thorough test, but has come to the conclusion that it is no good, and is about to abandon it entirely. But it has no intention of abandoning incandescent lighting. On the contrary it is going to put in one of the new Brush low tension dynamos, which is guaranteed to give 420 incandescent lights of 20 candle power each for 42 horse-power, and run the lights direct from its central station. The people have had a taste of incandescent lights and like them, and the company has no desire or intention of surrendering to the gas people yet awhile.

I notice that the West House, which, by the way, is, take it for all in all, as good a hotel as any one ever need to ask for, and better, in most respects, than many that call themselves first class, is wired for incandescent lights, and has "combination fixtures" which carry both gas jets and electric light bulbs. Provision is made for about 3,000 lights, and I understand that the direct Brush system is to be used. The hotel already has a 65 light Brush arc machine, and illuminates liberally. It will next put in a Brush incandescent dynamo, and use gas as little as possible.

Standard Time.

When the system of standard time was adopted by the railroads of the country, and the map of the United States was divided into four belts or districts, with a difference of one hour between the time of each district and that of the adjoining one, there were necessarily some localities in which the change was so great as to be sensibly observed These were points on or near the dividing line between two districts. At the boundary, for instance, between the Eastern and central districts—the one governed by the seventy-fifth, the other by the ninetieth meridian—the local time would, of course, vary half an hour from either. To conform to the standard of the eastern district would require that the clocks should be set forward half an hour. If the standard of the central district were adopted, they must be set back half an hour. And it was naturally to be expected that in cities and towns thus situated objection would be made to the enforcement of the new system.

This has proved to be the case, and there are still some neighborhoods in which standard time is ignored, and local time heroically maintained. It is regarded by the people of those communities as an insupportable wrong that the working day should begin and close half an hour earlier or later by the sun than formerly, or else, if the sun is still to rule the day, that it should be 7.30 by the clock, eastern standard time, when the working hours begin, and 6.30 when they close. In like manner, the opening and closing of school, formerly occurring at 9 A. M. and 4 P. M., would be changed to 9.30 and 4.30. And at those times of the year when the sun rises and sets at 6 o'clock, the watch or clock regulated by eastern time would show 6 30, or by central time 5.30. This, it must be confessed, does not seem to constitute a very substantial grievance, especially as there is nothing to prevent the reckoning of local time by those who have the inclination to do so, the operation being a simple act of addition or subtraction. And it seems a straining of "local pride" beyond what the circumstances justify, to maintain a practice which leads only to confusion and misunderstanding. The fact that the railway time-tables are adjusted to the new system is the vitally important feature of the case. In these days of continual and universal travel, railway time is the one thing about which it is necessary to be accurate. And any of the imaginary inconveniences which have been referred to are of trifling account, compared to the derangement which is liable to result from a local standard of time differing from that by which the traveler must be guided.

Cincinnati is one of the points at which the adoption of standard time was opposed, and is still obstinately resisted. It is in the central district, but so far east of the ninetieth meredian, which governs that district, that its local time is 22 minutes faster than "central time," and to conform to that standard its clocks must be set back 22 minutes. This, its people resolved, should not be done, and accordingly they are still working under what a currency expert would call a "double standard." Of two leading Cincinnati dailies now before us, one gives a railway time table as the railway officials have it, but remarks at the head of the column, "To get Cincinnati time add 22 minutes." The other, evidently regarding this as a weak surrender to the enemy, gives only local time in its tables making the 9 o'clock train leave at 9.22, the 6.30 at 6.52, the 8.45 at 9.07, and so on, kindly stating in advance, however, that this is Cincinnati time, which is 22 minutes faster than central time. This is all harmless and amusing until a wayfarer, who desires to leave the city by a certain train, and who may have no reliable timepiece of his own, sees a clock on the street, or in an office or restaurant, and is panic-stricken to find that he has only three minutes to reach the depot, a mile or so distant. Desperately resolving to lower the record and overtake the train, he makes such speed as brings him to the depot in a state of perspiration and collapse, and finds that he has still twenty minutes of elegant leisure on his hands. The clock which demoralized him was keeping Cincinnati time; the hour of departure which he had in mind was central time. He expends his twenty minutes in mopping his face and anathematizing a community which indulges in the luxury of two time standards.

On the next occasion of this kind, he feels that he has grown wiser and is not to be stampeded a second time by a false alarm. He notes the hour by a clock in the shop window and reckons that he has 25 minutes for a deliberate saunter to his train. Reaching the depot in a tranquil frame of mind, he learns that the train has gone a quarter of an hour since. Without going back to investigate, he is safe in assuming that the particular clock consulted in this instance was controlled by some independent citizen not actuated by local pride, and was running by central instead of city time. Of course it would be so marked on the dial, but equally of course the warning would be overlooked by the average observer. As he has to wait four hours this time for another train, the inference may be risked that the last state of that man is worse than the first.

Telegraphers' Mutual Benefit Association.

The annual meeting of the Telegraphers' Mutual Benefit Association will be held in New York, on Wednesday, November 19th. It is designed to hold a meeting for organization and preliminary business in the afternoon, and adjourn until 8 P. M., for the discussion of new business and the election of officers.

At 6 P. M. sharp, a complimentary dinner will be given by the New York District to Delegates and visiting members from other Districts, to whom a cordial invitation is extended and to whom tickets will be given on their arrival.

To enable the Reception Committee to do its duty acceptably, and prevent confusion, members accepting this invitation are kindly requested to notify the Secretary thereof not later than November 1st.

JAMES D. REID,
Chairman Reception Committee.
CHARLES P. BRUSH, Secretary.

Progress of Electrical Science.

It is too soon to speak of the popular benefits of the Electrical Exhibition which has just closed in the city of Philadelphia. The affair has, in a degree, been spectacular, so far as the ordinary observer is concerned, and the eye has been somewhat excessively appealed to. But it is tolerably certain that the public is to-day much better qualified to talk intelligently about electricity and its marvelous application to lighting and machinery. At the bottom is the great mystery of electricity, which the exhibition was not intended to solve, and which nobody pretends to explain. Perhaps it will never be explained. The exhibition itself was undertaken with two objects in view, namely, the arraying of all known appliances by which electricity can be applied to quicken the progress of the civilized world, to the end that by contrast the perfections and imperfections of such appliances might be studied, and the popularizing of a science which is destined to play an important part in human affairs might be promoted. It would be to confess that the exhibition was a failure to assume that scientists have not learned a great deal during its continuance. Whether it has disclosed any secrets to the experts or not cannot now be known, nor can we expect to know at present if any inventor has gathered hints that may lead to valuable discoveries. The effects of the exhibition must probably be studied in the inventions that may follow. Now that the spectacle has passed away, unprofessional observers have time to reflect upon the wonders already achieved. In doing that they will prepare the popular mind for still greater wonders to be performed by the application of electricity. It needs no prophetic vision to discern, though dimly, much more marvelous things than those which now fill our souls with wonder. Already we have the electric light, which, in contrast with gas, appears to the ordinary observer about the perfection of lighting. In fact, the systems are rather experimental than otherwise. That the world will harness electricity and employ it as effectively as it now employs steam, does not seem an extravagance, if said. It may not supersede steam as a motive power or gas as an illuminator, in the sense of banishing steam and gas. But then it may do both in time. This exhibition has prepared the public for almost anything in that line. It has in a sense familiarized the popular mind with the power of electricity and the methods employed to utilize that power. If in doing so much the projectors have escaped pecuniary loss, the fact will afford gratification to every friend of progress. Our only regret is that the institute has not an endowment of a quarter of a million with which to prosecute its excellent work.—*Chicago Journal of Commerce.*

At the regular monthly meeting of the Franklin Institute, on Thursday night, Col. Charles H. Banes, the Director-General of the Electrical Exhibition, spoke upon its general results He said it was not only a success financially, but in other respects as well. No profit was expected, but he was glad to say there would be a balance in hand of $10,000 after the building, shafting, etc., are paid for. Speaking of the visits of the pupils of the public schools, he said that there were 13,162 such visitors to the exhibition; there were also pupils of 65 colleges and schools outside of the city who attended; 285,000 people visited the exhibition; the largest attendance during any one day was on October 7th, when 17,047 people were present; the smallest on September 3d, when 2,830 people were in attendance; the average attendance was 8,407 people. 105,000 electrical primers were printed.

Upon the very last day of the exhibition at Philadelphia an experimental electrical street car was run upon Thirty-second Street for the first time. This car is the invention of Mr. W. W. Griscom. The current is carried by a third or middle rail, and is returned to the motor through one of the outside rails after passing through the motor, which is situated on the front platform. The method of connection is by brushes rubbing along the rail. The motor of this street car is a 15 horse-power Griscom motor, differing, however, from the other Griscom motors in using an armature composed of a modified Gramme ring, instead of Siemens' armature. The current is derived from the Weston incandescent lamp dynamo machine. The test on Saturday was very successful, the machine starting, stopping and reversing easily.

Mr. Trouve's electric lamp for surgeons obviates the necessity of shifting the light with each movement of the patient. The entire apparatus is attached to a frontal plate, padded on the inside and secured to the forehead by an elastic band or by springs like those of a fencing mask, or by means of a spectacle frame resting on the nose, or it may be fastened to a cap or other headpiece. The lighting portion is mounted on the frontal plate by a ball-and-socket joint, the ball being united to a plate, which may or may not be furnished with a reflector, and which forms the end of a cylindrical casing, upon which fits a tubular socket carrying the source of light. It can be used in mining, etc.

Telephonic News

*** In forty-five towns of Germany the "Hello Central," or its equivalent in German, resounds. This is a poor showing of telephone business as compared with this country.

*** Notwithstanding the Royal decree regulating the conditions of the telephonic service in Spain, nothing has yet been done in the large cities toward introducing the use of the Telephone.

*** The Molecular Telephone Company are not succeeding very well at Ogden, Utah, in erecting an exchange. To do a telephone business it has been found necessary to have something more than a telephone and a line of poles.

*** Our correspondent at Calcutta furnishes us the following statement of the total number of telephone subscribers in East India on October 1: Calcutta, 244; Bombay, 204; Madras, 36; Rangoon, 98; Colombo, 34; Kurrachee, 25.

*** Experiments on long-distance telephony continue in England, and last Monday people spoke from Reading to Weymouth, a distance of 141 miles; on Wednesday the telegraph office of St. Martin's le-Grand, in London, was connected with Liverpool by telephones, and conversation was successful over a distance of 200 miles.

*** The Uruguayan Telephonica Compagnia, founded 1st February of the present year, numbered 632 subscribers on 1st July, notwithstanding the competition of the River Plate Telephone Company, with 450 subscribers, which had been in existence a long time previously. The former company use Blake-Bell, and the latter Gower-Bell instruments.

*** The Trinidad newspapers announce hat the director of the telephonic system of the ports of Spain has lately been removed by the parent company at New York and replaced by another engineer. The former director thereupon proposed the formation of a new telephonic enterprise, with a reduced price of subscription, and undertakes to finish the construction by January 1st, 1885.

*** The number of subscribers to the telephone system of Mayence, Germany, increases, and now amounts to 60. Communication with Frankfort will doubtless be established within two or three weeks. The construction of the line has been begun from both ends at once: from the Mayence end it already reaches Bischofsheim; and from the Frankfort end the work is being also pushed with the greatest activity.

*** Dr. Hipp, manager of the telegraph and electric apparatus factory at Neufchatel, has patented a microphone. The instrument works without induction coil, and is directly connected with the telephone line. A single range of batteries at the central station is therefore sufficient for working all the stations, and there is no need of a battery in connection with the subscribers' instruments. We shall know more about its utility after it is tried.

*** Our correspondent at Portland says that the telephone business is still on the increase in Maine. It is true some subscribers are dropping out, but their places are being filled by more substantial concerns, and the numbers are growing. Considerable heavy work is in progress in Portland and Lewiston. Two miles of high poles are going up in the heart of Portland. Three air cables of considerable length will also be suspended before winter arrives.

*** In raising the vessel La Provence, which sunk in the Bosphorus, the telephone was added to the diver's dress, thus greatly facilitating the communications. One of the glasses of the helmet is replaced by a copper plate, in which a telephone is inserted, so that the diver has only to turn his head slightly in order to receive his instructions and report what he sees. Besides, in case of danger or accident, lives may now be saved which would otherwise have been sacrificed.

*** The telephone companies in England are hastening to avail themselves of the facilities lately accorded by the Post Office Department, to establish a telephonic service between the different cities. As we have already noted, a line is nearly finished between London and Brighton, and will be ready for public use in a few weeks. The management of the Bell-Edison Company have lately made some experiments between London and Dover on the railway telegraph lines, which are 78 miles long. Trials were made of speaking on a single wire, and then on a metallic circuit; both experiments were perfectly successful.

*** During the month of September just past no less than 15,064 messages were exchanged by telephone between the subscribers to the telephone companies holding concessions and the telegraph offices which form the points of junction. Of this number 3,342 originated in Brussels, 2,904 in Liege, 2,841 at Antwerp, 2,345 at Ghent, 1,691 at Charleroi, 985 at Louvain, and 956 at Verviers. The whole population of Belgium does not much exceed that of London and its suburbs. It is stated that a definite understanding has been come to between the Belgian Government and the Bell Telephone Company for the working by this company of telephonic communications between towns on the Van Rysselberghe system; and that a few privileged individuals who have exchanged telephonic messages between Brussels and Antwerp find no greater difficulty than in speaking to any part of the capital.

Telephonic Synchronization.

A marine chronometer is placed in a cabinet, 21 cm. wide, 31 cm. deep, and 28 cm. high, attached to the walls of the Berlin magnetic observatory. The cover and two faces of the cabinet are made of looking-glass, which resounds well. The microphone is placed against the door opposite the wall, and permits of distinguishing the beating of the chronometer more distinctly than if it be placed to the ear. The chronometer beats the half-second, and is regulated by the mean time, while the clock beats the second, and indicates the astronomical time. Consequently the interval which separates two coincides is 3 min. 2½ sec. of mean time, or 3 sec. of astronomical time. The observer perceives through the cover the hour shown by the dial, the beating of the chronometer, and that of the astronomical clock. The correction is therefore made by taking as a starting point the interval between two coincidences. Daily and repeated experiments have proved that the irregularities of the chronometer are much more important than the probable errors caused by delay due to the telephonic transmission.—*Centralblatt fur Elektrotechnik.*

At Paris, Texas, on Friday last, the court heard applications for eleven injunctions against the Baltimore and Ohio Telegraph Company, brought in the name of the farmers and landowners along the Texas Pacific Railroad through this county, to restrain the Baltimore and Ohio from erecting its telegraph line along the right of way of that road. The landowners represent the interests of the Western Union Telegraph Company which company, after having been defeated in their previous applications in their own name and that of the Texas and Pacific Railroad Company, bought up from the farmers their interest in the railroad right of way, and applied to the courts through this medium, claiming that the condemnation of their land for railroad purposes still entitled them for damages, now that it was proposed to condemn the land for telegraph purposes. The court refused all these applications on the ground that while the damage to the plaintiff, if any, was trifling, the damage to the telegraph company by stopping the work would be irreparable.

The facetious editor of the New Orleans *Times-Democrat* propounds the following question:

"WHICH TELEPHONE, CASSIUS?"

"About this time of the year the average citizen is liable to be approached by a leading financial person of care-worn appearance, and spoken to in impressive confidence. It soon turns out that the financial person has in his possession a new and much-improved telephone, concerning the virtues of which he is disposed to be garrulous. He seizes your buttonhole in a nervous gripe, and proceeds to gorge you with information. After a brief survey of the past history of the telephone, and a light but withering comment upon the imbecility of everything previously created, he launches out upon a sea of eulogy as to his own. Why, sir, all rival concerns are the very poorest and most transparent swindles ever palmed off upon an unsuspecting world. He will discourse learnedly of 'receivers' and 'diaphragms.' He will expound the virtue of the horseshoe magnet, and describe a sensitiveness so delicate as to fill you with respectful amazement. What you don't know about the entrails of a telephone after that financial person gets through with you would have room to dance on the point of a cambric needle.

"Then the financial person passes sadly onward in search of some one else to transfix with his phosphorescent eye, and to load to the guards with his pent up science. You lean against some friendly wall and mop your throbbing brow, and try to collect the scattered and bruised fragments of your intellect. And then, before you can summon strength to flee the scene of your agony, there heaves in sight another man—also a financial person—a man with a concentrated optic and a whisker educated in the highest cult. Nothing melancholy or care-burdened about this person. Nay! he is jocund and chipper as the rosy dawn. He beams with pride. For he, too, has a telephone—something entirely new—the superiority of which is, out and away, the most triumphant proposition known to man. He does not prose and maunder. He is not filled with gloomy cynicism, or given to disparagement. He waves out of existence the claims of other telephones. He chirps and prattles about the perfections of his own. And he leaves you more idiotically muddled than before.

"Which is the real article—the original Jacobs? Which is the horseshoe and which the single-action magnet? Which is the one without a diaphragm, and which the one with a defective midriff? We must know these things. With bloodshot eye and hair in fine frenzy rolling, we demand that information which alone will arrest a mind now tottering to its fall."

We supposed that about all the lambs had been shorn by the floaters of the sundry "wild-cat" telephone schemes. Quite unlike the majority of the unsuspecting public, our esteemed contemporary is evidently not in haste to take stock in the various telephone financial jobs presented by the numerous alleged telephone companies, whose industrious financial representatives are growing daily conspicuously less, notwithstanding their harvest has been a fruitful one. If the question were a serious one, and any doubt really existed as to the original patentee of the telephone or as to its final issue, we think the decision rendered last week would be a sufficient answer.

We will repeat, for the information of our contemporary, that on the 23d ultimo the examiners-in-chief of the Patent Office, in the celebrated telephonic interference patent case, sustained the decision of the examiner of interferences in favor of Prof. Bell, as to issues A, B, C, E, F, I, J and L, which involve the principal features of the telephone, and have reversed the decision so far as it applied to case "G," which was awarded to McDonough; that, also, the examiners-in-chief have now decided in Bell's favor. This decision confirms again Professor Bell's patent, which, together with many kindred patents of value upon apparatus used in this business, is owned and controlled by the American Bell Telephone Company.

Our Canadian cousins claim, in their report of the Public Works department, that Canada possesses greater telegraphic facilities than either the United States or any European country. The number of offices in Canada is one to every 1,914 of population based on the census returns of 1881, while in Switzerland the proportion is one to 2,500; in the United States, one to every 3,700; in Germany, one to every 4,300; in France, one to every 6,231; and in Great Britain, one to every 6,508.

Old Cable Stories.

By F. C. Webb.

The Cagliari (or rather Chia) and Bona cable did not give results that satisfied the officers of the Mediterranean Telegraph Company and the French Government; and it was decided that we should proceed to work at it in the Elba. We had also to pick up all the cable remains of four attempts made by Mr. Brett to lay cables from Chia to Algeria. These consisted of two pieces of heavy 6-conductor cable and two pieces of 3-conductor cable. The 6-conductor cable had been laid from shore in the sailing ship Result in tow to some 30 miles; then there had been a run, and the cable had to be cut. They then under-run a few miles from shore, cut, and spliced on, and paid out about 22 knots, and then had a run and cut. The 3-conductor cable, laid from the Dutchman steamer, had been laid to some 90 miles, when there had been a run, and cable was broken or cut. Then they under-run from shore some 20 miles, cut and spliced on, and paid out till they ran short of cable near a small island on the coast of Algeria. They then hung on for some days till the cable chafed through on the rough bottom. We had therefore to try to pick up four different sections, two of which had ends on the beach, the other two lying isolated from the shore.

The Elba was fitted with a picking-up machine designed by Mr. Fleeming Jenkin, under the superintendence of Messrs. Newall, Liddell, and Gordon. On March 1st we had a discussion about the machine. It was thus arranged: Drum 6ft. diameter; spur-wheel, 9ft.; pinion, 2ft. 6in. Brake drum to be loose on shaft, but connected by palls to the cable drum, so that, if cable overpowered engine, pawls brought the brake into play, and as near as I recollect this was all carried out. The drum, spur gear, and brake were all between the bearings; the bow sheave was also properly fitted; and wooden buoys, designed by me and made by Cooper, of Hull, were supplied for the work, as also buoy and grapnel ropes of manilla.

I left to take charge of the work until Mr. Liddell could come out to us, and arrived at Bona on the 2d of June. The Elba arrived there on the 3d. There was much correspondence with Government officials, and some tests that detained us there till the 5th. Whilst lying off Bona, an English tug, with a crowd of gentlemen on board, came steaming up to us, and an Englishman in his shirt sleeves dashed on board and asked us for a ton of coals, as they had run short and could not fetch Bona without them. I found in the Englishman an old friend, Mr. J. Player, a civil engineer, who, with Mr. T. Snowden, of Middlesboro, had an interest in some mines near Bona. On board the tug was M. Thalabout (the Stephenson of France), and a number of French engineers and financiers. As a slight courtesy in return for ours, M. Thalabout sent us two bottles of brandy that had been kept for seven years on the roof of his house at Marseilles. It was so superfine that we only treated ourselves to a small liquor glass of it after dinner; but when the first bottle was exhausted we found that the steward had consumed the other in making his own nightly grog.

We arrived at Cagliari on the 6th. Mr. Liddell arrived the next day, and we started that night for Chia, and arrived there the next morning. We had with us Mr. Fleeming Jenkin, Mr. Francesi, Mr. Ternant, and Mr. Loffler. After various tests, it was determined to pick up some of the Bona cable, and on the 9th we got the end off the beach and began picking up, and picked up to 30.25 miles by the 12th, when we were in about 800 fathoms and had cut out a slight fault. We hung on till the 15th, in a fresh breeze, putting cable to rights, and then got cable aft and began paying out. We anchored with kedge when 4½ miles from shore to splice on some shore end, and again at one mile from shore, to splice on a new shore end, and then landed end. This was all the practical work we performed on the Bona cable; but we afterwards had ten days'

testing from a martello tower at Chia, as I shall relate further on.

On the 16th we grappled close to shore for Brett's 6-conductor cable, got it, hove it up, and buoyed end of seaward part, and picked up shore part into three fathoms, and then cut it. Went off to Cagliari, back again next day, and made some more official tests of Bona cable, and then got end we had buoyed on board, and began picking up. Had some difficulty in getting the slack carried away from drum. Rigged up a pulley to press on cable and keep it tight on drum, as the cable was a very stiff one, and the men could not keep it tight. We came to a splice which marked the spot where the 20 mile length began. Picked up to 14 miles, and came to a crossing of a 3-conductor cable, which we had been given to understand did not overlay it. We cut and buoyed with two nun buoys and Manilla rope, and put flag buoy near. We then went to work to get the end of the 3-conductor cable off the beach, but, after expending much labor in digging up ashore, we suddenly caught sight of it from the ship, just under us, and hove it up and cut it, and got end on board on June 21st. We picked up to our buoys on the 6-conductor cable, and then found the 3-conductor cable we were picking up was chafed through by the thick one, and the end came on board. We then picked up 6-conductor cable again, and picked up about a mile, so as to be clear of our 3-conductor, and cut and buoyed again. This brought us to the 23rd, when we commenced dredging for the 3-conductor. Got it on 24th, cut it, buoyed sea end, and picked up short piece. Blowing too hard for work till 27th, when we picked up buoy on our 3-conductor length, and commenced picking up again. Came to splice that marked the shoremost end of the 40 mile length of 3-conductor cable in 105 fathoms. Took angles to mark position. Kinks now kept coming in at the rate of 40 to the mile. Picked up 13 miles, when cable parted (in about 600 fathoms) just as a bunch of bends and kinks came to the bows. We did not try to grapple for the rest of this section. On the 28th we grappled for the shoremost end of the 40 mile length of three conductors. Hooked it one mile outside end, cut it and buoyed shoremost end of seaward section. Picked up the one mile; back to buoy, got end up, and commenced picking up. Got forty-two kinks in two and a-half miles. At seven and a-half miles, cable broke at a kink in about 400 fathoms. On the 29th we got hold of buoys on the 6-conductor section we had been working at. At 7:15 P. M. came to a heavy lift. Belt got off, but the pawls prevented drum from paying out; and Mr. Fleeming Jenkin was pleased, for he had strongly insisted on the pawls, although I was against them. When we had got the belt on we gradually hove in an immense skein of cable, consisting of three bights and a loose end. We had to stop it together and coil it down just as it was, and it covered the whole floor of the main cable hold. I have no note of the exact length of this skein, but it was at the end of the section which was twenty-two knots long. On the 30th we dredged near shore for the second portion of the 6-conductor cable. Got it, cut it, and buoyed short piece, and commenced picking up seawards. We continued picking up steadily until 4 A. M. of July 2nd, when, having twenty-seven miles in, we came to a grand kinkation, evidently at the end, although in cutting some of it away to get it on board we cut the actual old end off. We had to get tackles on mast end and yard arms to get it in. A photograph of this kinkation was to be seen for several years in the shop window of Mr. R. S. Newall in the Strand. In picking up one of our buoys the ship drifted on to the boat that was unshackling the buoy, and the fluke of the anchor caught on the back a poor fellow named Oliver, who was formerly mate of the old Monarch, and hurt him seriously. We went off to Gagliari, and the Italian doctors said no bones were broken, but they resorted to their favorite remedy—they bled him. He was ill for many weeks at Cagliari.

More tests had to be taken of the Bona cable, as its state was under dispute; and on the 7th of July I landed at Chia with Messrs. Francesi, Cavalli, and Pacetti. There was a martello tower perched up on a high promontory, and this was to be our abode. It had not been inhabited for years. The entrance was about 18 or 20 feet from the ground, and we had to procure a ladder to get in. When we went in an old owl and a falcon flew out, and we fonnd a nest of young falcons inside. Into this tower we took provisions and some bedding, and stopped there altogether 10 days. I slept in the casemate the first night, but the feeling that all sorts of slimy things were dropping about the walls caused me to move the next night on to the roof, where we always took our meals. We had rigged up a sail, and tried to keep it quiet with numerous crossings of No. 8 wire; but from the exposed position of the tower the wind generally kept it flapping about in such a furious way that we could hardly hear one-another speak at times. We used to go down the grassy slope of the hill in our night gear to a little cove to bathe; but when we were coming away I noticed the dorsal fin of a shark right in this little cove, and I do not think I should have bathed if I had seen him before. We were pretty jolly and got on very well together. I learnt some more Italian; and, by the time we left, my three Italian friends knew considerably more pieces of recitatives from Italian opera than they did before, and were constantly bursting out with them. We had the wires led up in the tower and made experiments on them every day, Mr. Liddell, Mr. France, and Mr. Loffler being at Fort Genois, near Bona, at the other end of the cable. A *process verbal* was finally drawn up, but I not know how matters ended. I should have mentiomed that Spartivento and Chia are considered to be most deadly, unhealthy places. In fact, they used to say that Italian men-of-war would always sheer away from the land when obliged to pass near there, and it was considered fearfully dangerons to sleep ashore. Nevertheless, Mr. Liddell, and Mr. Loffler, and a whole party of men were caught ashore there one night by its coming on to blow, and had to pass the night in the open air. When they came off to the ship, all took some quinine in case of accidents, but nothing occurred. Of our party in the Chia Tower, one of the servants got the fever, but the rest of us escaped. There were certainly some nasty stagnant looking ponds near; and very likely it was the strong sea breeze that prevented Mr. Liddell's party from getting the fever.

In 1858 the Cagliari and Malta cable broke down, and I repaired it in January, 1859, in the Elba. The fault was near Adventure Bank in 175 fathoms; but there was nothing in the case that would be of interest now, as the repair of cables of that type and lying away from others is now constantly being carried out.—*London Electrician.*

It is the mass or weight of metal which conducts, not its surface, as some suppose.

1. The resistance of a conductor is proportional to its length. A wire two miles long will have twice as much resistance as a similar wire one mile long.

2. The resistance of a conductor is inversely proportional to its area of cross section. Wire one-half inch thick has four times as much resistance as wire one inch thick.

3. The resistance of a wire of given length and thickness depends upon the specific resistance of the material of which it is made.

4. When a wire of small resistance and an insulator of great resistance are employed upon a line, the highest excellence is secured, since the lower the resistance in the former the better is the transmission, and the higher the resistance in the latter the less the waste of current.

The Primers of Electricity, by Prof. E. J. Houston, now number 25 in all, and can be had upon application to the Librarian of the Franklin Institute. Price, 50 cents. Over 70,000 of these primers were sold during the exhibition.

The following is a complete list of subjects represented:

No. 1. Arc Lights.
" 2. Incandescent Lights.
" 3. Dynamo-Electric Machines.
" 4. Voltaic Batteries.
" 5. Electric Circuits.
" 6. Effects of an Electric Current.
" 7. Magnetism.
" 8. Electro-Magnetism.
" 9. Electricity Produced by Friction.
" 10. The Telephone.
" 11. The Microphone.
" 12. The Storage Battery.
" 13. The Electric Telegraph.
" 14. Electro-Metallurgy.
" 15. Electric Motors.
" 16. The Transmission of Energy.
" 17. The Lightning Rod.
" 18. The Galvanometer.
" 19. Electric Measurements of Minute Time.
" 20. Electric Clocks.
" 21. Synchronous Multiplex Telegraphy.
" 22. Electric Arc Lamps.
" 23. The Ruhmkorff Induction Coil.
" 24. The Jablochkoff Candle.
" 25. Sources of Electricity.

It is announced by the International Ocean Telegraph Company that, owing to the breaking of the cable south of Jamaica, telegraphic communication between Cuba and the other Antilles, with the exception of Jamaica, is interrupted. During the interruption messages will be sent by steamers from Santiago de Cuba for Puerto Rico and San Thomas on the 5th, 15th, 17th and 25th of each month, from Jamaica for San Thomas on the 10th of each month, and from Jamaica for Barbadoes on the 24th of each month.

The Association of Railway Telegraph Superintendents.

The Association of Railway Telegraph Superintendents held their third annual meeting at Philadelphia, the 17th September. Quite a large delegation was present, and an interesting session was had. Matters pertaining to the advancement of the telegraph service were thoroughly discussed.

The election of officers for the ensuing year resulted in choice of C. Selden, of Baltimore, for President; E. C. Bradley, of Columbus, Ohio, for Vice-President; and P. W. Drew, of Chicago, for Secretary and Treasurer. Vote of thanks was given the retiring Pressdent, W. K. Morley, to whom the organization of the association was largely due. Cleveland, Ohio, was chosen for next place of meeting, the third Wednesday in June, 1885.

The members of the association visited the International Electric Exhibition, and as the railroads are giving into the charge of Superintendents of Telegraph, all electric appliances used in their business, including electric lights, signals and telephones, they were very much interested in these exhibits, as well as in insulators, batteries, conduits, cables and instruments. Copies of the minutes of the annual meeting, with revised constitution, will soon be published, and can be obtained upon application to the Secretary.

.... The Western Union Telegraph Company has never stamped its guarantee of principal and interest upon the $6,000,000 of Mutual Union bonds, as per agreement at the time of the lease, and gives as a reason that a suit brought by Josiah Reiff to annul the lease is still in existence. This suit was brought in the New York Superior Court to annul the lease of the Mutual Union to the Western Union, on the ground that the necessary consent of two-thirds of the stockholders of the former company had been obtained by circular, and not at a meeting of stockholders duly called and held. The court granted an injunction; whereupon a meeting of the stockholders of the Mutual Union company was called and the lease was ratified by two-thirds of the stock. This fact being shown to the court, the injunction was dissolved, and the plaintiff appealed. The appeal, however, has been allowed to drop from the calendar of the General Term of the Superior Court, and there the matter rests, and is likely to rest. This explanation is considered inadequate by Mutual Union bondholders and a suit to annul the lease is talked of.

TELEGRAPHIC

.... It is announced that the color of the French telegraphic money-order blanks is about to be changed. The tint of canary-yellow has been chosen.

.... The receipts of the French telegraph department during the first six months of this year, were $2,630,120, or $181,400 less than the estimated receipts for that period.

.... The Boston District Telegraph Company are now in the field, in competition with the Mutual District Messenger Company, and the boys of the former company can be seen on the streets now, "actually *running.*" New brooms, etc.

.... The number of dispatches transmitted during September last over the line of the Cuba Submarine Telegraph Company was 3,644, which produced a revenue of $10,000, as against 2,616 despatches and a revenue of $12,375 for the same month of the preceding year.

.... It appears that the French Ministry of Posts and telegraphs are now planning a project to open a certain number of telephone offices connected with the telegraph system, with a view of placing them at the disposal of the subscribers to the telephone central offices.

.... Apropos of my article on "The Ticker," the Financial Telegram Company are getting ready for business here, and will soon be in shape to go ahead. They propose to give the Gold and Stock a good lively competition. Will give you a description of their apparatus shortly. L.

.... The submarine cable between Victoria and Tasmania (Van Diemen's Land) has been interrupted since July 29th. The fault was located at 90 miles from the Island of Flinder, and the steamer Southern Cross has been sent by the Eastern Telegraph Extension Co. to grapple for the cable and repair it.

.... Agreeably to a convention concluded between the Austrian Minister of Commerce and the Minister of Posts and Telegraphs in Hungary, the Bourses at Vienna and Buda-Pesth have been placed in direct telegraphic communication since October 1st. The Ten-felhart apparatus is used, the speed of which is alleged to be twice that of the Hughes.

.... In 1883, the extent of electric telegraph wire in actual use in New South Wales was 17,272 miles, 41 chains, 35 links; the number of stations, 368; the revenue, £134,643 2s. 4d; and the expenditure (exclusive of interest on cost of construction of lines), £163,328 16s. 11d. 2,107,288 telegrams, of the value of £165,276 14s 10d., were transmitted from the Colony; and 2,102,044 telegrams, of the value of £159,095 2s. 1d., were issued in the Colony. The New South Wales receipts on local and intercolonial (exclusive of New Zealand) business were £122,891 0s. 7d.; on New Zealand business, £1,898 15s. 1d; and on international business, £3,049, making the total receipts £127,838 15s. 8d.

.... An Italian inventor has recently constructed an apparatus for the telegraphic transmission of stenographic signs. This apparatus has been working for some time, regularly, for the reporting of the proceedings of the Italian Senate. The transmitter is composed of two series of ten keys, each one of which is used for a special sound. Each key acts in reality like a Morse key, in sending a current to the receiving instrument. The latter consists of a combination of 20 Morse receivers, furnished with a little style, which traces its particular signal on the paper, and in this manner reproduces the stenographic dispatch. It is claimed that this system presents great advantages as to speed, estimating the speed of the Morse apparatus at 500 words per hour, the Hughes at 1,200, the Wheatstone at 1,800, and the new system at 10,000 words per hour.—*La-Lumiere Electrique.*

Glimpses of the International Electrical Exhibition.

By Prof. E. J. Houston.

TELEPHONING WITHOUT WIRES.

Prof. Houston remarked—After consultation with our president, I have concluded that it will not be advisable in the limited time of a single meeting to attempt to discuss all the topics mentioned, since that would be more than can comfortably be completed. I will, therefore, confine myself this evening to a few remarks on the subject of telephony. I wish, however, to be distinctly understood that I do not mean to attempt to describe all the varieties of telephones exhibited at the Exhibition, since that would take longer than the time at my disposal. I wish rather to call your attention to a few of the many novelties in telephony which were presented by the various exhibits, and I believe that we can find abundant material if we consider some of the apparatus exhibited by Professor Alexander Graham Bell and by Professor Amos E. Dolbear.

The mechanism of the magneto-electric telephone is so generally understood that I need not stop to describe it. This species of telephone, as you are well aware, is a contrivance by means of which speech is readily transformed into electricity; the electricity so produced is transmitted over a conductor, and transformed at the other end of the conductor into speech. The telephone, therefore, is practically a dynamo electric machine, in which the steam engine for driving the same is replaced by the voice. The electricity so produced traverses the conducting wire, and entering a second dynamo, which acts as a motor, produces motions in a diaphragm which result in the reproduction of the original speech.

Without going into any further description of the telephone permit me to call your attention to some very beautiful experiments conducted by Professor Bell, which resulted in the discovery by him that the conducting wire, usually employed for transmitting the electric current, could be replaced by a beam of light. This discovery resulted in the invention of an apparatus called by Bell the *photophone*, and now generally known under the name of the radiophone. Noticing a photophone on exhibit in the collection of the Bell Telephone Co., I prevailed on the gentleman in charge of the exhibit to bring the instrument to the institute, so that I might have the pleasure of showing it to the members and explaining the method by which it is operated.

Before doing so, however, it may be well to briefly review what has been done with apparatus of this character, and in this direction I cannot do better than to call your attention to an elaborate series of experiments conducted by Professor Bell in connection with Mr. Sumner Tainter, an account of which is published in a paper read before the American Association for the Advancement of Science, in Boston, August 7, 1880.

The experiments carried on by these gentlemen were originally made with a view of studying the causes of the curious sounds emitted when a vibratory beam of light was permitted to fall on certain substances. These experiments were first carried on with the then rare element selenium, but they were afterward extended to other materials which were found to produce the same phenomena. Among some of the substances which they found would emit sounds when vibratory beams of light were permitted to fall on them are gold, silver, platinum, iron, zinc, lead, copper, hard rubber, celluloid, gutta percha, ivory, paper and wood.

In order to produce these effects, alternations of light and darkness, following each other with a certain rapidity, were permitted to fall on plates of the substances named, when musical sounds were emitted, the pitch of which was dependent on the rapidity with which the light and shadow succeeded one another. By properly modifying these alternations of light and shadow, even articulate speech was thus obtained.

It is not, however, to this method of causing light to produce sound that I wish to call your attention, but rather to the possibility of using a beam of light in the place of the conducting wire ordinarily used in telephonic communication. In order the better to do this, it may be well to give some little attention to the properties of selenium, as this is the substance now used in connection with Mr. Bell's photophone.

Selenium was discovered in 1817, by Berzelius, while conducting a series of experiments on the refuse of some sulphuric acid works. Noticing a peculiar odor emitted by the refuse, and ascribing it to the then rare metal tellurium, he endeavored to separate this element from the refuse. Without asking your attention to the very excellent work he performed in this connection, I will simply mention that, as the result of a series of elaborate experiments made on the refuse, he obtained, not the element tellurium, for which he was seeking, but an entirely new element which he named selenium.

Selenium, as obtained by Berzelius, is a non-conductor of electricity. There are, however, different forms in which it can be obtained. If selenium is rapidly cooled from a fused state, a form known as the "vitreous variety" is obtained. This variety has a dark brown color, when in thin films, is transparent to ruby red light, and is a non-conductor of electricity. When, however, fused selenium is slowly cooled, a variety known as "crystalline," or "granular selenium," is obtained. This is opaque to light, is of a dull, lead color, and is a conductor of electricity.

The conducting power of selenium is, however, exceedingly slight, its electric resistance, as compared to that of ordinary metals, being enormous. It was the fact of its great electric resistance that induced Willoughby Smith to employ selenium in his system of cable testing and signaling during submersion, for the high resistance at the shore end of a submarine cable. When so employed, phenomena were observed, which eventually led to the invention by Mr. Bell, of the photophone.

Although the introduction of the selenium resistance at the shore end of the cable readily afforded the high artificial resistance required, yet Mr. Smith was exceedingly puzzled to find that its value was subject to remarkable fluctuations. Patiently investigating the cause of these variations of resistance, he at last discovered the exceedingly curious fact that the electric resistance is much less in the light than in the dark. He announced this discovery in the Society of Telegraph Engineers on the 17th of February, 1873. As might naturally be expected, this peculiar property of selenium was at once investigated by scientific men in different parts of the world, and several varieties of selenium, varying very greatly in their conducting power for electricity, in the light and in the dark, were obtained. For example, in February, 1876, Dr. C. W. Siemens obtained a variety of selenium whose conductivity was fifteen times as great in the sunlight as in the dark.

Previous to the investigations of Bell and Tainter, the variations in the electric resistance of selenium by light were shown by the use of a galvanometer inserted in the battery circuit in which the selenium was placed. As long as the electric resistance remained constant, the needle was motionless, but when light was flashed on the selenium, since a greater electric current then traversed the circuit, the needle of the galvanometer was at once deflected. Now, when Prof. Bell began his investigations on selenium, it occurred to him to replace the galvanometer by a telephone. From his knowledge of this latter instrument, he readily appreciated the fact that, in order to obtain its greatest sensitiveness, it would be necessary to cause a very quick succession of variations in the intensity of light to fall on the selenium; for, in the magneto-electric telephone, it is only at the moment of change in the intensity of the current that any audible effect is produced by the diaphragm. He therefore rapidly varied the alternations of light and shadow by permitting an intermitting beam of light to fall on the selenium resistance. Under these circumstances, a musical note was heard, the pitch of which was dependent on the rapidity with which the variations in the intensity of light followed one another. These experiments enabled him to announce on the 17th of May, 1878, in a lecture delivered at the Royal Institution of Great Britain, the possibility of hearing the fall of a shadow.

From these experiments, the idea naturally suggested itself to him of employing a beam of light in place of the conducting wire ordinarily employed in telephony.

Now, what must we have in order to apply the principles already explained as to the variations in the electric resistance of selenium, by the action of light, to permit us to talk along a beam of light? We used a beam of light to replace the conducting wire. We need an arrangement by which this beam of light shall be varied in its intensity by the action of the voice, and a contrivance by which the beam so varied shall be permitted to fall on the surface of a selenium resistance which is included in the circuit of a voltaic battery and a telephone. Under these circumstances, a person talking against an apparatus, which we will subsequently explain, causes rapid variations in the intensity of the beam of light. These variations, being imparted to the beam, produce corresponding variations in the amount of current that flows through the circuit. These, in their turn, produce in the diaphragm of the telephone movements, which are translated by the ear of the observer into articulate speech.

The most important part of a photophone is evidently the selenium resistance. These resistances are generally made in the form of what is known as selenium cells. Previous to the time of Bell and Tainter these cells were not in a condition suitable for use in connection with an ordinary telephone. The least resistance of any selenium being, I believe, about 250,000 ohms in the dark. Such cells, of course, could not be used in connection with a telephone. Messrs. Bell and Tainter, however, succeeded in making cells whose resistance is about 300 ohms in the dark, and about 150 in the light. It is such cells that are employed by them in connection with their system of radiaphony.

Messrs. Bell and Tainter attribute their success in lowering the resistance of their selenium cells to the use of substances like brass that exert a slight chemical action on the selenium. This action, in the opinion of Mr. Bell, prevents the selenium from acting towards other substances somewhat like greasy water does, and so ensures the contact of an extended surface instead of a series of minute contacts. The selenium cell we will employ this evening is formed of alternate metallic disks of brass separated by disks of mica, of slightly smaller diameter; the spaces between the brass disks over the mica being filled with selenium. The alternate brass disks are connected together as are also the selenium disks; that is to say, the selenium cell is coupled in multiple-arc.

Let us now inquire what must be done to the beam of light in order to permit it to be suitably varied in intensity by the action of the voice. As I understand Mr. Bell's invention in the art of articulate radiaphony, it consists in the use of an undulatory beam of light in distinction from a vibratory beam. He claims, I believe, that it is not possible to transmit articulate speech by means of a pulsatory beam of light, that is by means of alternations of light and absolute darkness. What he does is to produce variations in the intensity of the light that correspond with the variations in the amplitude of the sound waves produced by the movements of the plates of the diaphragm. This he accomplishes as follows: A parallel beam of light is permitted to fall on a flat plate of thin glass, which is covered with a film of bright metallic silver. This plate is fixed at its edges in a manner similar to the diaphragm of the telephone. If, now, a speaker talks against the back of the plate, the sound waves set it into vibration and cause it to become alternately convex and concave. These changes, you will readily understand, will result in alternately causing the parallel rays of light in the beam to diverge and converge and thus to illumine the selenium cell more faintly or more brightly, but at no time to cut off all the light from it. In other words, the effect of the voice of the speaker against the plane silvered reflector is to produce undulatory, photometric variations in the beam of light that falls on the selenium resistance.

In order that you may be able to see these variations in the photometric intensity, I will illumine a cloud of smoke by means of a parallel beam of light. When now the voice is permitted to fall against the plate you will observe the very pronounced manner in which the breadth of the beam is altered.

Mr. Wilson, of the Bell Telephone Company, who had charge of the Bell exhibit at the Exhibition, has kindly consented to operate the apparatus for me, and I will now show you in actual operation, the process of talking along a beam of light. The limits of our lecture-room would naturally prevent a fair trial as to the success of the experiment, since any remark a speaker made at one end of the beam of light could be distinctly heard across the air space by the observer at the telephone. I have, therefore, connected the telephone by means of a metallic circuit with a room on the floor above, and an observer in that room will be able to hear all that is spoken against the plate in the lecture-room.

The light we will use for this purpose is the lime light. Arranging the lenses of the lantern so as to obtain a parallel beam of light, I allow it to fall on the plane silvered mirror before described. When, now, we talk against the plate, the beam of light is caused to vary in the manner we now see, and this undulatory beam falling on the selenium pile, which as we see is placed at the focus of a parabolic reflector, produces corresponding variations in the current that traverses the circuit of the battery and so permits articulate speech to be re-produced in the telephone.

Another experiment in telephony made at the exhibition may not be devoid of interest. I allude to the experiment tried by Professor Dolbear with his ingeniously constructed electro-static telephone. This instrument, as you are aware, is not magnetic in its action, and works on a principle entirely distinct from that of the magneto electric telephone, the vibrations of the diaphragm being caused by the attractions and repulsions produced in two parallel conducting plates. The peculiarity of this experiment consists in the fact that with this instrument we can telephone, not only without wires, but without even a beam of light. Holding a telephone to the ear and having its terminals not connected with any metallic conductor at all, we can walk around a room and yet in all positions hear what a person is saying, who is talking into the telephone at the other end of the line. When I speak of a room, however, you will understand that I refer to a room of the size of that occupied by Professor Dolbear at the Exhibition, which was about eight feet square.

If you regard this experiment as being somewhat incredible, I can assure you of its truth for I have tried this experiment myself. The phenomenon, however, is difficult to understand; indeed, like many other surprising things in science, it is difficult to explain why such an experiment was not tried sooner, but as we all know, it is those very things that are apparently so simple that require the greatest ingenuity to originate.

The explanation of the phenomenon, as I understand it, would appear to be somewhat as follows: One of the plates already referred to, being connected through the body of the observer to the ground, is thus joined to one end of the telephone circuit; the other plate is connected to the other end of the circuit by a line of polarized air particles. The experiment is simply an exceptional application of the principles of electro-static induction, and I am not at all sure but what it may be susceptible of a great increase in delicacy and thus become of considerable commercial value.

Electric Lighting at the International Health Exhibition in London.

The cascades at the ends of the two ponds which run down each side of the grounds, the Pavilion and grounds of the Water Companies' exhibit, and the Duke of West-

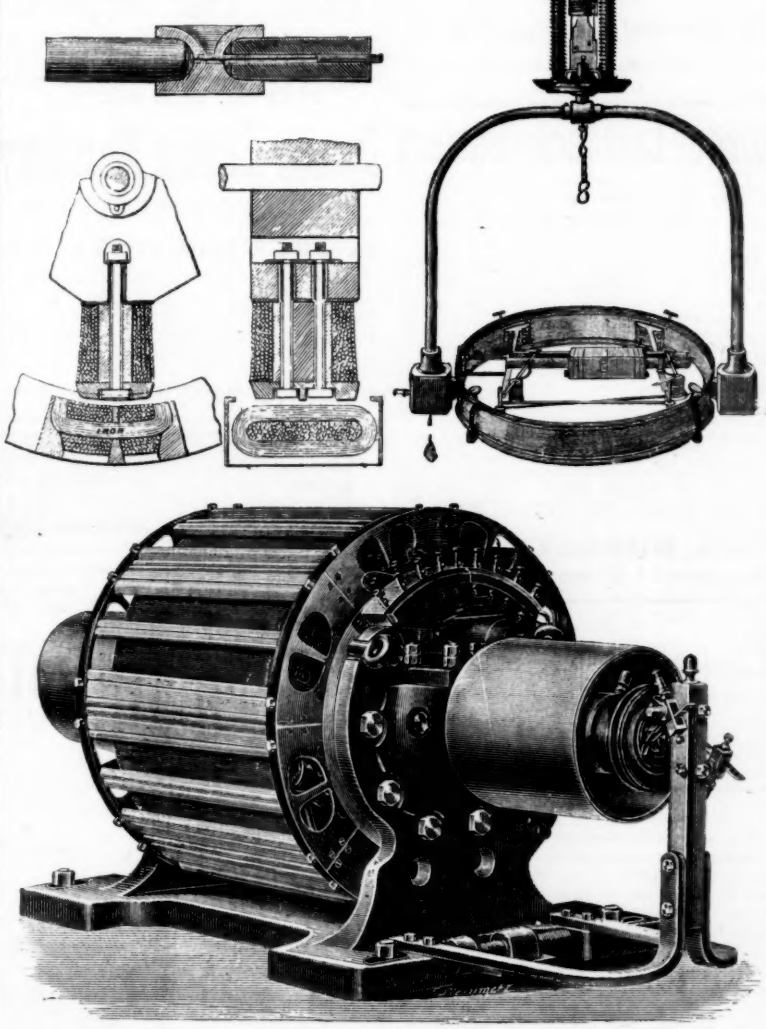
minster's iron column, are illuminated by the Electric Sun Lamp and Power Company. Since the date of our former notice the sun lamp, or as it was then called the "lampe soleil, has undergone considerable simplification, and the complicated block in which the carbons were burned has been reduced in size and cost. The principle, however, remains the same. The light-giving power of the voltaic arc is entirely subordinated to its heating capacity, the carbons being practically hidden from view within a block of Carrara marble, through which the arc plays, raising it to a high pitch of incandescence. The glowing stone gives off rays of a warm and golden tint which differ very much in their character from those of an ordinary arc lamp, being quite free from the usual moonlight character, and very steady. The light depends upon the temperature of the marble, and consequently does not readily respond to variation in the structure and composition of the carbons, or to oscillations in the speed of the engine. The block acts as a reservoir of heat, and likewise forms a guide for the arc, which cannot travel round and round the carbons, casting a brilliant light to one side and little or none to the other, as it is very apt to do when left to its own regulation. The effect obtained at the Health Exhibition is very pleasing, particularly at the cascades, and by its ruddy glow catches the eye immediately, being distinct from the appearance of both arc and incandescent lamps of the ordinary type. There are twenty-two lamps in all—five in the Water Companies' Pavilion, five on the Duke of Westminister's standard, four on the cascades, four in the engine sheds, and four in the store-room.

The annexed engraving shows diagrammatically the essential part of a sun lamp. Two carbons, each about 6 in. long, are pressed by spring into two recesses in a block of marble. One of the carbons is tubular and carries within it a second carbon pencil, which can be pushed forward when desired, through a passage joining the two recesses, until it meets the other—that is, the solid carbon. The object of this is to enable the arc to be established when the lamp is started or when it becomes accidentally extinguished. Formerly, when the two carbons met at an angle, instead, as now, of being in the same straight line, they were joined by a wick of carbon, as in the Jablochkoff candles, but this did not permit of their being readily relighted, and has been abandoned in favor of the present arrangement. Below the line of the recesses into which the carbons abut, and centrally between them, is an inverted crater, from which the light is emitted. A section of this crater taken in the center line of the carbons is conoidal, while a section at right angles to this resembles an inverted gutter. The whole of the under surface becomes incandescent, and throws its light downwards in diverging directions covering an elliptical area of floor space. This is a great improvement on the original form of the marble block, which emitted a cone of light which at moderate elevation did not cover a large area. For most indoor purposes, and also for street lighting, a greater length of illumination is required in one direction than another, and a lamp which gives an equal effect all round wastes much of its power on the walls and other surroundings. The marble block is mounted in a cast-iron box, from the opposite sides of which there emerge 2 tubes to carry the carbons. These are constantly pressed towards each other by arms attached to the ends of coiled springs, as shown in the lower figure on the preceding page, which illustrates a sun lamp with the globe removed. The inner carbon, which establishes the arc, is either operated by hand or automatically, according to the construction of the lamp. In the former case a cord, depending from the lamp, is attached to a rod which abuts against the pencil, and when the cord is pulled the rod is pressed forward and then recedes as the cord is released. When the action is automatic there is mounted on the frame a high resistance solenoid in a derived circuit. When the circuit is established the current raises the core of the solenoid. This is coupled by a lever and a pawl and ratchet wheel to a drum, around which there passes a weighted cord connected to a lever attached to the carbon pencil. When the core rises the pencil is pushed forward, and as soon as it touches the opposite carbon a fresh circuit is opened to the current across the arc. The solenoid is cut out of circuit by the safety switch described below, immediately loses its power, and its core falls, rotating the drum and drawing back the pencil to establish the arc.

All the lamps are arranged in series, and therefore need to be supplemented by self-acting switches to prevent the extinction of one breaking the circuit to all the rest. A switch is mounted above each lamp, and comprises a solenoid with two mercury contacts. When the circuit is intact the solenoid is in series with the arc, and as long as the lamp is alight the current flows through it, keeping the core raised, and holding one of the contact pieces it carries out of the mercury cup which is situated below it. When the arc is broken the core descends, and a fresh path is opened for the current. It enters the lamp at the positive terminal and passes into the first cup; from thence it goes by a contact wire carried on the core into a second cup, and through a resistance coil to the negative terminal. This apparatus is shown on the top of the lamp in Fig. 2, the resistance being made in two parts, one at each side of the solenoid. The solenoid core is counterweighted in a very ingenious manner. One of the mercury cups below it is made larger than is necessary for the transmission of the current and receives a pear-shaped float depending from the core. By adding or removing a few drops of the fluid the equilibrium of the core can be regulated as desired. In the automatic lamps metal contacts are substituted for the mercury cups as they remain in action only a moment, and the resistance coil is wound on a hollow bobbin to form the solenoid mentioned above.

The lamps at the Health Exhibition are fed by an alternate current machine, which we illustrate on the preceding page. It is the invention of Messrs. Clerc and Bureau, who also brought out the sun lamp, and bears a general resemblance to the Gramme alternate current machine. Upon a central spindle there is mounted a twelve-sided boss, to which twelve magnet cores, of the cross section shown below, and of a length dependent on the length of the machine, are bolted. The bolts are not screwed directly into the cast-iron, but are secured by nuts let into grooves in the boss. The magnet cores are wound with wire so arranged that the poles are alternately north and south, and they are excited by a current from a Siemens D_2 dynamo. This current enters and leaves by brushes bearing against collector rings at the end of the spindle, and passes through internal conductors to the magnet.

The induced current is generated in fixed coils. This arrangement gives great facilities for varying the electromotive force and the intensity of the current, as the coils can be readily grouped either in series, or in parallel, or in compound parallel, according to the purpose for which it is intended. Or the coils may be divided into independent groups, and some connected to arc lamps, some to incandescent lamps, and some to sun lamps,



THE CLERC AND BUREAU DYNAMO.

without any fear of the one affecting the other. For installations, where works and offices are to be lighted from the same generator, this is a great recommendation. The outer bobbins together form a kind of stationary Gramme ring. Each is wound on an iron core of a form shown in the cross section. The form of this core is claimed by the inventors as a special feature of their design. It is not, as in the Gramme ring, entirely hidden within the wire in which the current is induced, but it is bent round at the edges and brought out, so that it is subjected to the direct inductive influence of the revolving magnets. Each core is fitted with two wooden side pieces, which constitute the cheeks or flanges of the coil, and a wooden central rib which divides the coil into two parts. These pieces of wood project beyond the ends of the coil, and are attached to brass segmental end pieces, which together form a circle, which is carried by the standards of the machine. The ends of the conductors are brought out to a grouping table provided with binding posts, which can be coupled together in any desired order.

The machine shown in the illustration revolves at 600 revolutions per minute, and at that speed gives a current of 12 amperes, with an electromotive force of 1,200 volts. It is designed to feed twelve lamps of 2,500 candle-power.—*London Engineering.*

ELECTRICAL AND SCIENTIFIC

—— The United States Electric Light Company are putting in a large plant at Omaha, in addition to the 105 arc lights they now have running there.

—— The electric lighting apparatus on the dome of the Court-House at Wabash, Ind., was considerably damaged last Wednesday night by a flock of wild geese.

—— An exhibition of Russian and foreign products was opened last week in Odessa. The numerous pavilions and parterres are lit at night by the electric light.

—— The theatre of the city of Bjornborg, in Finland, is about to be lighted with 130 incandescent lamps. The Compagnie Anglo-American Brush has undertaken the installation.

—— The light of the sun has been studied at Glasgow by Sir William Thomson, who estimates its intensity at 24 times greater than that of a Swan incandescent lamp furnishing 240 candles per horse-power.

—— According to a despatch addressed to the *Standard*, last month, the city of Temesvar, in Hungary, inaugurated the electric lighting of its streets on that day. A complete installation of the Brush system has been made for the permanent lighting of the city.

—— The attention of the public has been attracted during several days past, on the boulevards in Paris, to a coupe illuminated both inside and out by incandescent lamps. The horse also carries a little light in the shape of an aigrette on his head. The current is furnished by accumulators.

—— The new first-class ironclad, the Ruggiero di Lauria, of the Italian navy, has been provided with a complete electric light installation, comprising arc regulators and incandescent lamps furnished with the Mangin projectors. The dynamos were made at the Government workshops at Spezzia, where all the electrical machinery for the Government is constructed,

—— Two new ships of the English navy, the Reindeer and the Linnet, are each about to be provided with electric light installations, comprising a Victoria dynamo capable of feeding arcs of 26,000 candles. The motor is of the Brotherhood type, with three cylinders. The dynamo has been specially constructed for aboard ship lighting, and will revolve at a speed of only 600 revolutions per minute.

—— A *fete* has been held in Dublin at which a number of Weston arc lamps have been used. These gave so much satisfaction that another *fete* was given, at which a still larger number of the lamps were employed. The lights were very brilliant, and were much admired by a numerous and critical assemblage. The arrangements were under the management of the Maxim-Weston Company, who supplied the whole of the plant.

—— Unlike the telephone, the electric light has not been taken up to any extent at Antwerp. The large goods station is thus illuminated, and the proprietor of a *cafe* adopts it as an attraction, taking his power from a neighboring manufacturer's engine. There is here a fine field for a company who would generate current at a central station and supply it to subscribers for electric lighting, as the Hammond Company does at Middlesborough.

—— The packet boat San Martin, belonging to the Compagnie Lloyd Argentino, has recently been equipped with an Edison-Swan electric light installation. The power is furnished by a Tangye machine of 10 horses, which drives an Edison-Hopkinson dynamo of 200 lights. The number of lights in use is 157, distributed throughout the vessel. This is the fiftieth packet boat which has been furnished with similar installation by the Edison-Swan Company.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING OCTOBER 28, 1884.

307,081 Amalgamating table; Samuel Bear, Brooklyn, N. Y., assignor of three-fourths to Leo Schlesinger, Sidney H. Carr, and Jacob Blumauer, all of New York, N. Y.

307,082 Amalgamating apparatus; Samuel Bear, Brooklyn, N. Y., assignor of three-fourths to Leo Schlesinger, Sidney H. Carr, and Jacob Blumaur, all of NewYork, N. Y.

307,095 Railroad-crossing gate; Oliver H. Clark, Pittsburgh, Pa.

307,096 Electric circuit for railroad-crossing gates; Oliver H. Clark, Pittsburgh, Pa.

307,097 Electric circuit for railroad-crossing gates; Oliver H. Clark, Pittsburgh, Pa.

307,104 Indicator for electric circuits; Thomas L. Dennis, Newburyport, Mass.

307,106 Telephone station apparatus; George F. Durant, St. Louis, Mo.

307,166 Incandescent electric lamp; James W. Benson, North Adams, Mass.

307,231 Printing telegraph; Robert J. Sheehy, New York, N. Y.

307,232 Printing telegraph; Robert J. Sheehy, New York, N. Y.

307,233 Printing telegraph; Robert J. Sheehy, New York, N. Y.

307,234 Printing telegraph; Robert J. Sheehy, New York, N. Y.

307,261 Dynamo-electric machine; Charles H. Benton, London, England, assignor of one-half to Hubert Henry Grubbe, same place.

307,270 Holder for incandescent electric lamps; Carl Dornfeld, Cologne, Germany.

307,287 Electric time-controlling system; William F. Gardner, Washington, D. C.

307,290 Magneto-electric machine for telephone signaling; Ezra T. Gilliland, Boston, Mass., assignor to the American Bell Telephone Company, same place.

307,292 Dynamo-electric machine; Hermann A. Gorn, New York, N. Y.

307,314 Connector for electric railway-train signals; Fred P. Marshall, South Evanston, assignor of two-thirds to F. R. Myers and G. W. P. Atchison, both of Chicago, Ill.

307,387 Electric motor; William W. Griscom, Philadelphia, Pa.

307,388 Dynamo-electric machine; William W. Griscom, Philadelphia, Pa.

307,389 Incandescent electric lamp; Hubert H. Grubbe, London, England, assignor of one-half to Charles H. Benton, same place.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

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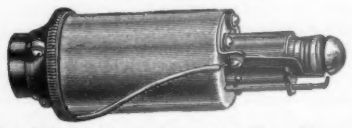

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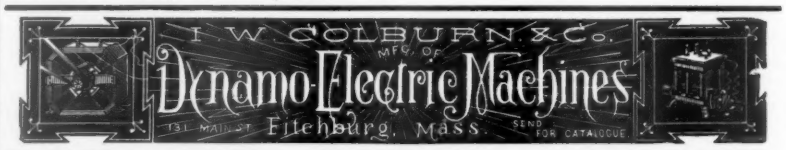

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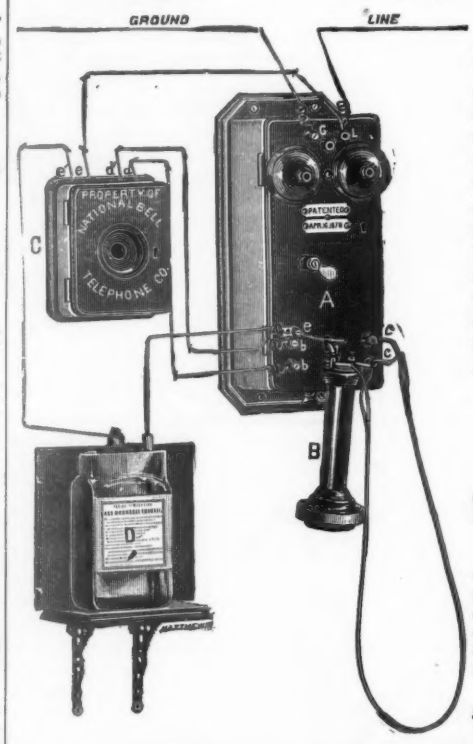

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